501-215/NOAA
G.3

Mission Operations And Data Svstems Directorate

Detailed Mission Requirements (DMR) Document for National Oceanic and Atmospheric Administration (NOAA)-K, -L, and -M

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DMR Issue 1

November 1993

NASA
National Aeronautics and Space Administration
GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

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. PAGE TITLE: APPROVAL AUTHORITY		2. REPLACES	3. PAGE NO: 1010
		DATED:	4. DATE November 1993
i. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO. UPN 615-3	8. REV. NO.

). AUTHORITY (REFERENCES)

a. NASA Management Instruction (NMI) 8430.1C
b. Execution Phase Project Plan for NOAA-K, -L, -M
c. Mission Requirements Request (MRR) (refer to attachment A)

10. REMARKS
This DMR applies to the NASA Office of Space Communications (OSC) managed resources in support of the NOAA-K, -L, and -M missions. Any other reference is supplied only for completeness of the document.

PROJECT CENTER(S)		SUPPORT CENTERS	
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1130	X	Mission Operations Concept
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1311		Launch Vehicle Characteristics
1312	X	Launch Vehicle Drawing
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1322	X	Spacecraft/Payload Drawing
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1720	X	Launch Vehicle Trajectory Data
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2005	X	RF Telecommunications - Summary Tables
2020	X	RF Telccommuniutions - Telemetry Frame Structure
2030	X	RF Telecommunications - Command Word Structure
2100	NA	Space Network (SN) Requirements - Summary
2110	NA	SN - Tracking Requirements
2120	NA	SN - Return Link Requirements
2130	NA	SN - Forward Link Requirements
2200	x	Deep Space Network (DSN) Requirements - Summary
2210		DSN - Radiometric Requirements

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2220	X	DSN - Downlink Requirements
2230	X	DSN - Uplink Requirements
2240	-	DSN - Multimission Navigation
2250	-	DSN - Monitor and Control
2300	-	Ground Network (GN) Requirements - Summary
2310	-	GN - Radiometric Requirements
2320	-	GN - Downlink Rquircmcnts
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2630	NA	International Networks - Uplink Requirements
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3000	X	Testing and Training Rquircments
3100	X	Compatibility Testing
3200	X	Network Readiness Testing
3300	X	Mission Readiness Testing
3400	X	Simulators and Test Tools
3500	X	Training
4000	X	Mission Operations Center Requirements - Summary
4100	X	Mission Operations Systems Requirements
4200		Flight Software Maintenance Rqukments
4300	-	Facilities Rquircmcnts
4400	X	Mission Operations Support Rquircmcnts
4600	-	Other Control Center Capabilities
5000	X	Ground Communications and Data Transport Requirements - Summary
5100	X	Ground-to-ground Data Transport Rquircments
5200		Additional Ground Communications
6000		Data Processing Requirements - Summary
6100		Real-time Data Processing Requirements
6200		Non-Real-time Data Processing Rquircmcnts
6300	-	Dam Archive/Storage Requirements
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7100	-	Attitude Determination and Control Requirements
7200	-	Trajectory Requirements
7300	-	Attached Payload Requirements
Appendix A	X	Mission Requirements Request (MRR)
Appendix B	-	Lead Center Exceptions
Appendix C	-	Database Information

9. Description

Term	Definition
A&E	activation and evaluation
AFSCN	Air Force Satellite Control Network
AIP	AMSU Information Processor
AKM	Apogee Kick Motor
AMSU	Advanced Microwave Sounding Unit
APT	automatic picture transmission
ARIA	Advanced Range Instrumentation Aircraft
ATN	Advanced TIROS-N
ATNAGE	Advanced TIROS-N Aerospace Ground Equipment
AVHRR	Advanced Very High-resolution Radiometer
BCA	beacon/command antenna
BDF	block data format
BPSK	Bi-phase Shift Key
c c s	Command and Control Subsystem
WA	command and data acquisition (NOAA stations)
C&DH	command and data handling
CEMSCS	Central Environmental Satellite Computer System
CIC	CPU Interrupt Code
CIU	controls interface unit
CPU	central processing unit
CTT	Compatibility Test Trailer (DSN)

9. Description

Term	Definition
CTV	Compatibility Test Van
c x u	controls interface unit
DAU	decryption and authentication unit
dB	decibel
dBci	decibel circular isotropic
dBi	decibel isotropic
dBm	decibel referenced to 1 milliwatt
DCS	Data Collection System
deg	degrees
DGIB	DSN/GSFC interface block
DHS	Data Handling Subsystem
DOC	Department of Commerce
DPM	Deputy Project Manager
DPU	data processing unit
DSN	Deep Space Network
DSS	Deep Space Station
DSS 16	Goldstone, CA, 26-meter DSN station
DSS 17	Goldstone, CA, 9-meter DSN station
DSS 46	Canberra, Australia, 26-meter DSN station
DSS 66	Madrid, Spain, 26-meter DSN station
DIR	Digital Tape Recorder
ELT	Emergency Locator Transmitter

9. Description

Term	Definition
ELV	expendable launch vehicle
EPIRB	Emergency Position Indicating Radio Beacon
ESA	Earth Sensor Assembly
ETE	end to end
FBKS	Fairbanks, Alaska CDA station (NOAA)
FCS	Flight Control System
FDF	Flight Dynamics Facility
ft	feet
FM	frequency modulation
FOT	flight operations team
GAC	global area coverage
GHz	gigahertz
GRD	ground receiver/demodulator
GRTS	Goddard Real Time System
GSFC	Goddard Space Flight Center
GSTDN	Goddard Spacecraft Tracking and Data Network
HIRS	High-resolution Infrared Radiation Sounder
HRPT	High-resolution Picture Transmission
IGS	Inertial Guidance System
IRV	improved interrange vector
IMP	instrument mounting platform

9. Description

Term	Definition
IMU	inertial measurement unit
IRV	interrange vector
JPL	Jet Propulsion Laboratory
kb/sec	kilobits per second
kHz	kilohertz
km	kilometer
LAC	local area coverage
LAN	Lannon, France
LCR	Launch Control Room (Suitland, Maryland - NOAA)
lb	pound
LCP	left circular polarization
LEO	launch and early orbit
LOS	loss of signal
LSB	least significant bit
LUT	local user terminal
Mb/sec	megabits per second
MCR	Mission Control Room
MEPED	Medium Energy Proton Electron Detector
METSAT	Meteorological Satellite (Project)
MGC	Missile Guidance Computer
MHz	megahertz

9. Description

Term	Definition
MIRP	Manipulated Information Rate Processor
MM	Martin Marietta Corporation
MMA	mission management area
MMAS	Martin Marietta Astro Space (Hightstown, NJ)
MOA	memorandum of agreement
MO&DSD	Mission Operations and Data Systems Directorate
MOM	Mission Operations Manager
MOSA	Mission Operations Support Area (GSFC)
MRR	mission requirements request
NA	not applicable
NASA	National Aeronautics and Space Administration
Nascom	NASA Communications Network
Nav	navigation
NCC	Network Control Center
NESDIS	National Environmental Satellite. Data and Information Service (NOAA)
nmi	nautical mile
NMI	NASA Management Instruction
NOAA	National Oceanic and Atmospheric Administration
NOCC	'Network Operations Control Center (JPL)
NRZ	non-return to zero
NWS	National Weather Service

9. Description

Term	Definition
OBP	onboard processor
OAFB	Onizuka Air Force Base
OSC	Office of space Communications
OSSA	Office of Space Science and Applications
PACS	Polar Acquisition and Control System
PCM	pulse co& modulation
PM	phase modulation
RA	Right Ascension
rad	radians
RCP	right circular polarization
REA	reaction engine assembly
RF	radio frequency
RT	realtime
RTS	Remote Trucking Station (AFSCN)
Rx	receiver
RXO	redundant crystal oscillator
SAD	solar army drive
SAR	search and rescue
SARR	search and rescue repeater
SARP	search and rescue processor
SARSAT	search and rescue satellite-aided tracking

9. Description

Term	Definition
SBUV	Solar Backscatter Ultraviolet Radiometer
S/C	spacecraft
SCU	signal conditioning unit
SEL	Space Environmental Research Laboratories
SEM	Space Environment Monitor
SLA	search and rescue L-band antenna
SMC	Satellite Missile Center (Sunnyvale, CA)
SOA	S-band OMNI antenna
SOCC	Satellite Operations Control Center (NOAA)
SRA	SAR receiver antenna
STIP	stored TIP
T&C	telemetry and command
TBD	to be determined
TDFS	TIROS Dynamic Flight Simulator
TED	Total Energy Detector
TELEX	central exchange-type teletype service
TIP	TIROS Information Processor
TIROS	Television Infrared Observation Satellite
TTY	teletype
TWX	central exchange-type commercial teletype service
UDA	UHF DCS/SARP receive antenna

9. Description

Term	Definition
UHF	ultrahigh frequency
USAF	United States Air Force
USSPACECOM	United States Space Command
VAFB	Vandenberg Air Force Base
VHF	very high frequency
VRA	very high frequency real-time antenna
W	watts
WOMS	Wallops Island, Virginia, CDA Station
WR	Western Range
XMTR	transmitter
XSU	Cross Strap Unit

1. PAGE TITLE: Responsibilities for Management, Implementation, Operations, and Services		2. REPLACES	3. PAGE NO: 1064
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9. Organization/Title	10. Responsibilities
1. Program Office	The Office of Space Science and Applications (OSSA), is responsible for the overall direction and evaluation of TIROS program.
2. Program Director	The Earth Science and Applications Division, is the TIROS Program Directorate.
3. Project Center	Richard Beck, of the Earth Science and Applications Division, is the primary point of contact at National Aeronautics and Space Administration (NASA) Headquarters for all matters relating to the TIROS Project.
4. Project Manager	Charles E. Thienel, Metsat Project Manager, is responsible for all phases of TIROS Project planning, direction, engineering, integration, evaluation, and reporting. He is assisted by Lawrence T. Draper, Deputy Project Manager (DPM); David A. Coolidge, TIROS Systems Manager; Arthur M. Unger, TIROS Observatory Manager; John A. Underwood, DPM/R; John M. Hayes, TIROS Instrument Manager; Dr. Joel Susskind, TIROS Project Scientist; Lloyd G. Green, Data Systems Manager (DSM); Leroy H. Anderson, Orbit and Trajectory Manager, and Francis J. Lawrence, Launch System Manager.
5. Launch Vehicle Manager	Donald Miller, Flight Projects Directorate, is responsible for coordinating spacecraft requirements using the Titan II launch vehicle, injection and onboard propulsion system, and transmitting these requirements for implementation.
6. NOAA Mission Operations Manager (MOM)	Walter H. Asplund, Flight Projects Directorate, is responsible for organization of network and National Oceanic and Atmospheric Administration (NOAA) ground systems support for post-launch operations and satellite checkout.
7. Mission Support Manager (MSM)	Jeffrey S. McKenzie, Flight Mission Support Office, is responsible for all Mission Operations and Data Systems Directorate (MO&DSD) support to the TIROS Project. This includes coordinating the requested Air Force Satellite Control Network (AFSCN) and Deep Space Network (DSN) support.
8. Search and Rescue (SAR) Mission Manager	Ronald G. Wallace, Flight Projects Directorate, is responsible for research and development leading to the enhancement of SAR operational capabilities.
9. Tracking and Data Systems (TDS) Manager (DSN)	Edward B. Luers, DSN Tracking and Data System (TDS) Manager, is responsible for coordinating spacecraft support requirements for the DSN.

1. PAGE TITLE: Compliance to Aerospace Data System Standards and Other Applicable Documents		2. REPLACES	3. PAGE NO: 1066
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9. Description

Applicable Aerospace Data System Standards

Standard	System/Compliance	Deviations	Waivers/Remarks
DSN/Flight Project Interface Design Handbook, 810-5, Revision D, Volume I	a. TLM: Yes b. CMD: yes		

1. PAGE TITLE: Project Description		2. REPLACES	3. PAGE NO: 1100
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9. Description

GENERAL DESCRIPTION

The NOAA-K, -L, and -M spacecmft are operational followers of NOM-H, -I, and -J, and will be designed to provide an economical and stable platform for the advanced instruments to be used in making measurements of the Barth's atmosphere. its surface and cloud cover. and the proton and electron flux near the Earth. As part of this mission, the spacecraft will also have the ability to receive, process, retransmit data from free-floating balloons and buoys, as well as remote automaticobservation stations distributed around the globe and to track those stations that are in motion. The NOM-K, -L, and -M spacecraft will continue to provide a satellite-aided SAR system.

10. PROJECT OBJECTIVES

A. The general project objective is to procure, develop, test, and launch four spacecraft. To meet NOAA's critical requirement for continuous and dependable operation of the polar orbiting satellite element of its satellite system. a primary objective will be to have the launch of NOAA-K in 1995, with subsequent spacecraft of the series available for launch at U-month intervals thereafter.

B. The specific project objectives are as follows:

(1) Provide data necessary for operational monitoring of weather processes to be utilized in producing routine meteorological analyses and forecasts

(2) Provide for distribution of meteorological analyses to the National Weather Service (NWS) and international meteorological organizations

(3) Contribute to the development of a domestic and international in situ environmental data collection network, which will provide timely observations from remote regions for use in environmental warning services and enhancements of basic environmental services.

(4) Provide for the reception and relay of emergency distress signals to aid the Search and Rescue Satellite-aided Tracking (SARSAT) operations.

(5) Provide instrumentation to improve the capability for forecasting and providing real-time warnings of solar disturbances.

(6) Provide for monitoring the vertical distribution of atmospheric ozone and total ozone concentration in the atmosphere on a global basis.

(7) Provide for growth in the kind, quantity. and quality of environmental parameters measured.

(8) Extend knowledge and understanding of the atmosphere and its processes (for example. by viewing the evolution and motion of storms and other atmospheric phenomena) to improve short- and long-term weather forecasts.

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9. Description

	MILESTONES	CY 1995				CY 1996				CY 1997				CY 1998				CY 1999			
		1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
1	LAUNCH/START OPS																				
	NOAA-K		▽																		
	NOAA-L							▽													
	NOAA-M												▽								
2	EXPECTED OPS PERIOD																				
	NOM-K										▽										
	NOM-L															▽					
	NOM-M																				▽

Note

1. The project plan is to launch satellites into alternating morning and afternoon orbits with a spacecraft lifetime design god of 2 years.

2. The project plan is to procure, develop, test and launch NOM-K. -L, and -M as indicated (tentatively) in the previous figure. The orbital segment will consist of one satellite with a morning descending nodal crossing time, and the other satellite with an afternoon ascending nodal crossing time.

3. The spacecraft orbital altitudes will be 450 Nautical Miles (nmi) and 470 nmi to prevent prolonged ground conflict periods. These orbits are polar and Sun-synchronous (but without orbit adjust capabilities) so that the required Earth coverage will be provided for the 2-year mission life.

4. All launch dates will be determined by a 4-month call-up status by the Metsat Project

Figure 1- 1. Planned Mission Milestones

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9. Description

General

The instrument systems provide both direct readout (real time) and onboard recording playback of environmental data during day and night operations The NOAA-K, -L, and -M spacecraft carries the following primary instruments:

a. Data Collection System (DCS).

b. Space Environment Monitor (SEM).

C. Search and Rescue (SAR).

d. Atmospheric Sounding

(1) Advance Microwave Sounder Units (AMSU-A1, -A2, and -B).

(2) High-resolution Infrared Radiation Sounder (HIRS/3).

e. Advanced Very High Resolution Radiometer (AVHRR/3).

f. Solar Backscatter Ultraviolet Radiometer (SBUV/2).

Data Collection System

The DCS collects telemetry data (temperature. pressure, and altitude measurements) using a one-way Radio Frequency (RF) link of 401.65 MHz from up to 4,100 data collection platforms in the form of buoys, k-floating balloons, and remote weather stations located throughout the world. The onboard DCS receives the incoming signal and measures both the frequency and relative time of occurrence of each transmission. The data is processed, formatted, and retransmitted via the Command and Data Acquisition (CDA) stations through the Satellite Operations Control Center (SOCC) to the central processing facility at Toulouse, France, and the U.S. Processing Center in Landover, Maryland. At the U.S. Processing Center, the data is distributed to users and stored on magnetic tapes for archiving purposes.

Space Environment Monitor

The SEM will provide the ability to monitor solar proton and electron flux density and the total energy disposition in the mar-Earth space environment The SEM is comprised of the Medium Energy Proton Electron Detector (MEPED), Total Energy Detector (TED), and Data Processing Unit (DPU). Data will be collected on a global basis. The detailed requirements for this instrument have been supplied by the Space Environmental Research Laboratories (SEL) it is expected that SEL will serve as the "contractor" for the SEM.

9. Description

Search and Rescue

The SAR instruments to be flown on the NOAA-K, -L, and -M spacecraft will provide the dual capability of detecting and locating existing Emergency Locator Transmitter (ELT)/Emergency Position Indicating Radio Beacon (EPIRB) operating in the 121.5 and 243 MHz bands to an average locution accuracy of 10 to 20km. Location determination with the 406-MHz band will also provide user classification and identification and allow for global coverage capability by providing spaceborne processing and storage.

Atmospheric Sounding

Three instruments ate used to determine radiances needed to calculate temperature and humidity profiles of the atmosphere from the Earth's surface into the stratosphere. These instruments arc the Advanced Microwave Sounder Unit (AMSU) and the High Resolution Infrared Radiation Sounder (HIRS/3). The AMSU consists of three functionally independent units: AMSU-A (A1-A2) and AMSU-B for obtaining data to compute atmospheric temperature and water vapor profiles, respectively.

AMSU-Al and -A2

AMSU-A is a line-scan instrument designed to measure scene radiance in 15 channels ranging from 23.8 to 89 GHz to permit the calculation of the vertical temperature profile from the Earth's surface to about 3 millibar pressure height. AMSU-A is divided into two physically-separate modules, each of which operates and interfaces with the spacecraft independently. Module Al contains all the S-mm oxygen channels (3 through 14) and the 89-GHz window channel (15). Module A2 contains the two low-frequency window channels (1 and 2).

AMSU-B

AMSU-B is also a line-scan instrument designed to measure scene radiance in five channels ranging from 89 to 183 GHz to permit the calculation of atmospheric water vapor profiles.

HIRS/3

HIRS/3 has 20 spectral bands, 19 in the infrared band and one in the visible band. This instrument is basically as the instrument flown on earlier spacecrafts. except for five spectral band changes to improve sounding parameter accuracy. The instrument measures scene radiance in 19 channels to permit calculation of the vertical temperature profile from the Earth's surface to about 40 km.

AVHRR/3

The AVHRR/3 is a six-channel scanning radiometer which views the same Earth area with each channel. The instrument scans ±55.40 degrees per scan line at a rate of 360 lines per minute and produces 3 data swath width of 2400 km. Data from the six channels prove I means to observe vegetation. clouds, lakes, shorelines, snow, aerosols, and ice. Temperatures of land, water, and sea surfaces as well as clouds are also observed.

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9. Description

SBUV

The SBUV/2 is a nonspatially-scanning, spectrally-scanning sounding radiometer. It is designed to measure scene radiance and solar spectral irradiance in the spectral range from 160 to 406 nmi. In the discrete mode, measurements arc ma& in 12 spectral bands from which total ozone and vertical disaibution are made. The sweep mode provides a continuous spectral scan from 160 to 406 nmi.

9. Description

The NOM-K -L, and -M series of spacecraft will be launched by a modified Titan II supplied by the United States Air Force (USAF). A solid-propellant Star37 XFP will perform the launch injection maneuver. The overall length of the vehicle, including an aluminum fairing is 11432 feet (34.84 m), and the maximum body diameter is 10 feet (3 m). The Titan II is a two-stage vehicle. Both stages (I and II) use liquid hypergolic propellants. The fuel, Aerozine 50, is a blend of 50 percent hydrozine and 50 percent unsymmetrical dimethylhydraxine. Nitrogen tetroxide is used as the oxidizer. The spacecraft is attached to the launch vehicle by means of a conical attach fitting 58.4 inches (1392 m) wide. The Inertial Guidance System (IGS) consists of an Inertial Measurement Unit (IMU), which is a gimbaled platform with three gyro accelerometers, and a Missile Guidance Computer (MGC), which is a random-access, thin-file, core-memory, parallel, binary, digital computer. The Flight Control System (FCS) stabilizes the vehicle attitude in all flight phases from launch through payload separation. The FCS establishes the flight path by implemenuing all steering commands issued by the IGS. The FCS consists of MGC software, stage 1 and 2 attitude rate sensing system and hydraulic actuator on the stage 1 and 2 engines

The NOM-K, -L, and -M spacecraft will be launched from the Western Range (WR), placed into a polar orbit, and checked out before handover to the National Environmental Satellite, Data and Information Service (NESDIS). This effort will be performed by the NOAA/SOCC Flight Operations Team (FOT) and directed by the TIROS MOM using NASA/DSN, USAF, and NOAA ground systems

PRELAUNCH TEST PHILOSOPHY

Before spacecraft delivery to WR, a series of tests will be performed to verify telemetry and command compatibility between the spacecraft, NOAA/SOCC, and supporting ground systems. These tests will verify that the Polar Acquisition and Control System (PACS) software is capable of commanding the satellite from the stations listed in Section 2000 (encrypted and decrypted modes). The tests will also verify that the Pulse Code Modulation (PCM) telemetry stream received from the satellite can be processed accurately by the SOCC PACS.

After spacecraft delivery to WR, another series of tests, in the form of mission simulations and data flows, will be performed to verify telemetry and command functions and interface compatibility with all of the ground stations which are part of the TIROS launch operations network.

SPACECRAFT CHECKOUT PHILOSOPHY

Spacecraft activation begins soon after liftoff, usually around the second orbit, at which time power is supplied to the various subsystems and the initialization process occurs. This Launch and Early Orbit (LEO) period is completely under NASA control and lasts approximately 5 days. Upon completion of subsystems initialization. the test and checkout of the instruments will be performed. This Activation and Evaluation (A&E) period is dii by NASA, but NOM has responsibility for spacecraft health and safety.

All activity is directed from the NOAA/SOCC at Suitland, Maryland, and requires a minimum of 2 I Jays for completion of the activation, test and checkout phase.

9. Description

SPACECRAFT ON-ORBIT OPERATIONS PHILOSOPHY

Upon completion of checkout, the spacecraft will be handed over to NOAA/NESDIS, who will operate the spacecraft and ground system for the duration of mission life. In the event of an emergency, NOM may request Telemetry and Command (T&C) support from NASA/DSN and technical support fiom the Metsat Project

FUNCTIONAL ELEMENTS SUMMARY

The NOAA-K, -L, and -M ground segment is shown in the figure on page 1130.2. The GSFC Network Control Center (NCC). Nascom, and Flight Dynamics Facility (FDF) are institutional elements provided by the MO&DSD to support the ATN missions. The network ground coverage is provided by the Air Force Satellite Control Network (AFSCN), and the DSN. The AFSCN/Remote Tracking Stations (RTS) will provide telemetry support, and the DSN will provide housekeeping telemetry and commanding during L&EO and contingency activities The primary commanding and telemetry acquisition will be provided by the two NOAA/CDA stations at Wallops Island, Virginia, and Fairbanks, Alaska.

Support Summary

During launch, vehicle events and spacecraft boost data (16.64 kb/sec) will be sent to WR NASA TLM Lab and displayed. Events will be relayed by voice to GSFC and NOAA/SOCC. Spacecraft boost data will also be sent to NOAA/SOCC. An estimate of the mission orbit will be derived by WR and GSFC using the launch tracking data together with nominal Apogee Kick Motor (AKM) and velocity trim bums.

AFSCN and the DSN will be required to support the mission through Launch plus 4 days. NASA/DSN and AFSCN will receive 8.32-kb/sec real-time data on S-band and transmit this data via Nascom blocks to NOAA/SOCC (Destination Code 321 Octal).

All additional remote site data proassing and display requirements will be performed by NOAA/CDA stations.

Prelaunch predictions will be provided. Predictions for all participating sites and Interrange Vectors (IRV) for participating NASA/DSN and AFSCN stations are required for all TIROS missions. Copies of the predictions are required by the NOAA scheduler at NOAA/SOCC and the Metsat Project.

Satellite Operations Control Center

The NOAA/SOCC at Suitland. Maryland, exercises command control of the spacecraft, In addition to NOAA/CDA stations at Fairbanks, Alaska and Wallops Island, Virginia, the AFSCN/RTS's and DSN/26-meter subnet stations at Goldstone, California (DSS- 16 and 9m DSS- 17), Madrid. Spain (DSS-66). and Canberra. Australia (DSS-46) will be the supporting ground stations for the NOAA-K. -L, and -M missions.

9. Description

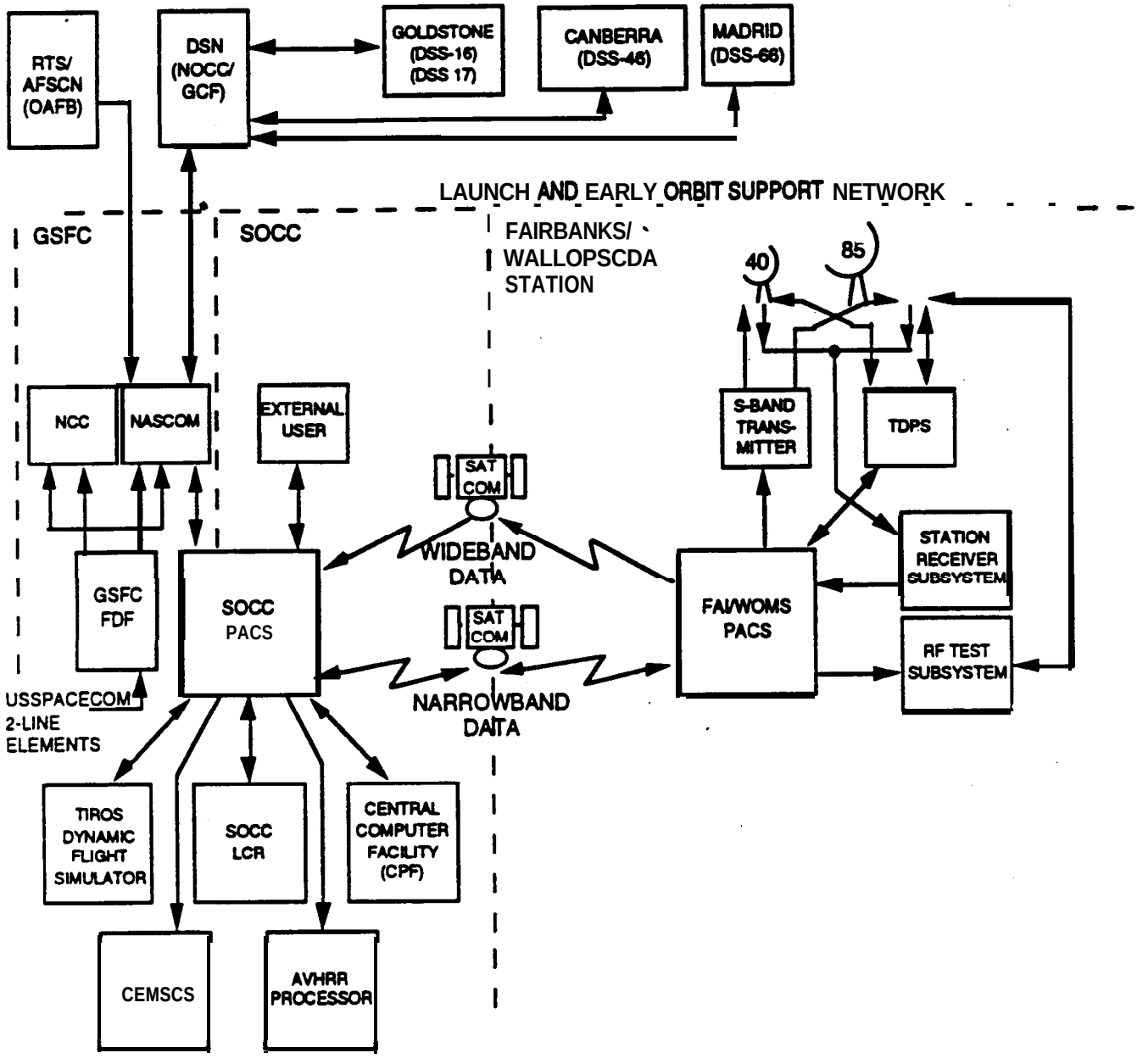

Figure 1-2. NOAA-K. -L. **and -M Functional Support** Diagram

9. Description

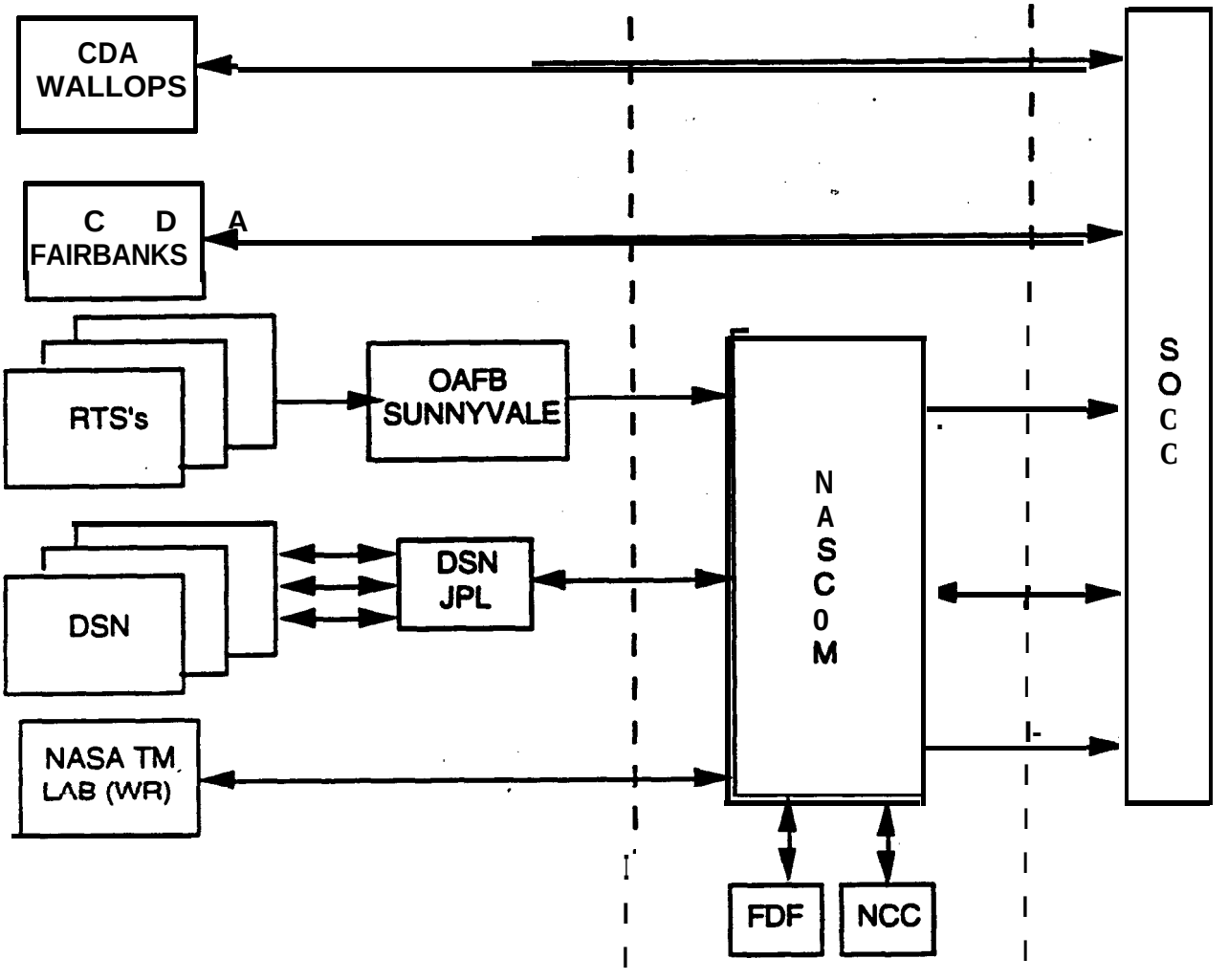

Figure 1-3. Launch Network

9. Description

The NOAA/CDA and NASA DSN stations will uplink telecommands generated by the SOCC/Polar Acquisition and Control System (PACS) at 2.0 kb/sec, NRZ-M on a 16-kHZ subcarrier. The downlink telemetry consists of 9 communications links between the spacecraft and the ground. The meteorological S-band links will be activated
during the support period covered by this document The S-band launch telemetry link (2247.5 MHZ) in the boost or orbit mode as well as the Very-high Frequency (VHF) beacon link will be active.

TIROS Information Processor (TIP) boost mode telemetry data stream at 16.64 kb/sec, split phase, is transmitted continuously by the S-band transmitter (STX-4) from launch to mission mode handover, received by the WR/NASA TLM Lab-ground station, and remoted in Nascom Block Data Format (BDF) to the NOAA/SOCC for processing. From handoff (termination of "boost" mode telemetry) to the "orbit" mode. 8.32-kb/sec data will be downlinked for the life of the mission. Telemetry data from the DSN will be provided in the format identified in the GSFC/DSN ICD.

Launch Site

Mission prelaunch and launch operations at WR will require communications to support integration, engineering data flows, End-to-End (ETE) testing, operations simulations, and launch. Voice and data communications as detailed on pages 5000 and 5100 will be required between WR and the NOAA/SOCC. Nascom will provide data switching and monitoring capabilities.

Integration and Testing

A series of RF compatibility tests will be performed at the spacecraft manufacturers facility. The GSFC Compatibility Test Van (CTV) and the JPL Compatibility Test Trailer (CTT) will interface with the spacecraft via coaxial cables or waveguide. These tests will verify interface compatibility between the spacecraft and the network, telemetry, and command systems. Nascom will provide communications support for these activities.

Flight Dynamics Support

a. Orbit Determination Support: Data from two or more sources will be evaluated in near-real time to provide the project with the best estimate of the mission orbit following launch. If necessary, this estimate will be used to update the nominal acquisition data for the supporting ground sites. Updated acquisition data_ along with scheduling and planning aids, will be generated for the A&E phase, which nominally lasts for 2 1 days following launch. Early orbit computation from USAF skin tracking is required for the A&E phase. and operational spacecraft orbit computation will be obtained from the USAF skin tracking. Based on a two- or three-line elements received from the United States Space Command (USSPACECOM) at Launch plus 3 hours, the FDF generates and transmits acquisition data to the supporting stations.

b. Attitude Determination: Attitude determination is the responsibility of the NOAA SOCC.

1. PAGE TITLE: Launch Vehicle Description • General		2. REPLACES	3. PAGE NO: 1310
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO. UPN 615-3	8. REV. NO.

9. Description

The *NOAA-K,* -L, and -M series of spacecraft will be launched by a modified Titan II supplied by the United States Air Force (USAF). A solid-propellant STAR 37XFP will perform the orbit injection maneuver. The overall length of the vehicle. including the aluminum fairing is 11358 feet (34.62 m), and the maximum body diameter is 10 ft (3 m). The Titan II is a two-stage vehicle. Both stages (I and II) use liquid hypergolic propellants. The fuel, Aerozine 50, is a blend of 50 percent hydrazine and 50 percent unsymmetrical dimethylhydrazine. The oxidizer is *nitrogen* tetroxide. The liquid rocket engines are hydraulically gimbaled and the propellants are fed by a turbine pump. The Stage I engine has two subassemblies which provide pitch, yaw, and roll control. The Stage II engine has one subassembly that provides pitch and yaw control. Roll control is provided by ducting turbine exhaust through a swiveled roll control nozzle. Each subassembly has a regeneratively-cooled thrust chamber, gas generator start cartridges, connecting plumbing, electrical and instrumentation wiring harnesses, pressure components, and turbine pumps. The Stage II engine has an ablative skirt nozzle extension. An autogenous pressurization system (cooled gas, fuel rich turbine exhaust, and vaporized nitrogen tetroxide) is used on the Stage II fuel tank and the Stage I fuel and oxidizer tanks to meet the engine pump suction head and in-flight structural pressure requirements. Stage I is separated from Stage II by firing gas-separated nuts and using the fin-in-the-hole separation technique. The spacecraft is attached to the launch vehicle by means of a conical adapter 56.15 inches wide. The Inertial Guidance System (IGS) consists of an IMU which is a gimbaled platform with three gyro accelerometers and a Missile Guidance Computer (MGC) which is a random-access. toroidal core memory, fixed-point, two's compliment digital computer. The Flight Control System (FCS) stabilizes the vehicle attitude in all flight phases from launch through payload separation. The system establishes the flight path of the vehicle by implementing all steering commands issued by the IGS. An Attitude Controls System (ACS) employs attitude control thrusters from Stage II shutdown prior to spacecraft separation. The FCS consists of a software program in the MGC, a Stage I attitude-rate sensing system, hydraulic actuators for Stages I and II, and a Stage II IMU which is used to determine attitudes, rates, and lateral accelerations.

Item	Stage One	Stage *Two*
Name	Titan II	Titan II
Thrust	430,000 lb	100.000 lb
Fuel Type	Fuel - Aerozine 50 Oxidizer - Nitrogen Tetroxide	Same as Stage I
Fuel Weight	Fuel - 89,800 lb Oxidizer - 169,500 lb	Fuel - 21,500 lb Oxidizer - 37, 600 lb
Gross Weight	268,500 lb	66,700 lb
Guidance	Inertial (Delco)	Same as Stage I
Tracking Aids	C-band	C-band

1. PAGE TITLE: Launch Vehicle Drawing		2. REPLACES	3. PAGE NO: 1312
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO. UPN 615-3	8. REV. NO.

9. Drawing

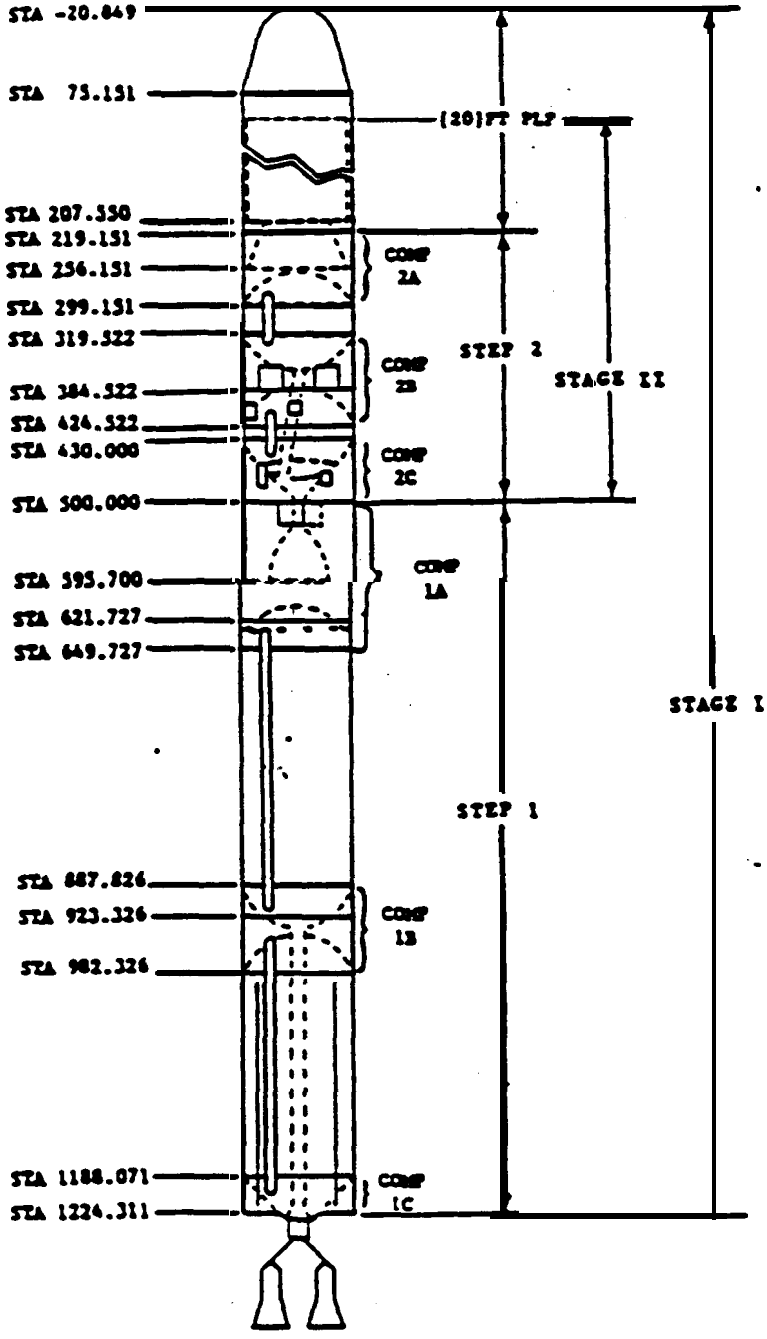

Figure 1-4. Launch Vehicle

9. Description

SPACECRAFT STRUCTURE

The NOAA-K, -L, and -M spacecraft structure is designed to support a complete meteorological payload as well as the necessary support subsystems to meet all interface and systems requirements. It meets the mechanical, thermal, and Field Of View (FOV) requirements with the required level of mounting accuracy for the payload sensors and maintenance of alignment throughout all phases of testing, launch, and on-orbit mission life. The structure consists of four major assemblies:

a Instrument Mounting Platform (IMP).

b. Reaction Control Equipment (RCE).

c. Solar Array. (SA) Assembly.

d. Equipment Support Module (ESM).

INSTRUMENT MOUNTING PLATFORM

The IMP is the precision instrument mounting surface, and houses those instruments that have the more-stringent pointing requirements or need an uninterrupted view of space for detector-cooling purposes. The IMP also supports the primary attitude-sensor quipment (Earth Horizon Sensor, Inertial Measurement Unit. and Sun Sensor). The IMP surface is the primary thermal control surface for the instruments, and houses an array of thermal control louvers which are protected from solar illumination by a Sun shade.

REACTION CONTROL EQUIPMENT/REACTION SUPPORT STRUCTURE

The Reaction Support Structure (RSS) is a cylinder reinforced by four external rings and 18 internal lon.gerons, which primarily supports a solid rocket AKM as well as the Reaction Control System (RCS) components. The RCS components consist of two nitrogen tanks. two hydrazine tanks, eight nitrogen thrusters, and four hydrazine thrusters along with the manifolding required to interconnect the system. ln addition, the RSS supports the spacecraft batteries, battery charge controllers, and certain antennas. It also furnishes support for the solar array assembly.

SOLAR ARRAY ASSEMBLY

The SA Assembly consists of 10 reinforced honeycomb panels, which are hinged to each other along their long edges. The array is approximately 6. IS m long by 2.73 m wide. During launch. five SA panels are stowed on each of the ESM back apex panels.

EQUIPMENT SUPPORT MODULE

The ESM contains the majority of the spacecraft electronic support quipment It is pentagonal in cross section, but asymmetric to provide a large Earth-viewing face on which lower pointing-accuracy instruments and antennas are mounted. The ESM houses *most* of the components contained in the data

9. Description

handling, attitude determination and control, communications, and command and control subsystems, as well as elements of the instrument components which do not require external viewing.

ATTITUDE DETERMINATION AND CONTROL SUBSYSTEM

The Attitude Determination and Control Subsystem (ADACS) provides ascent guidance and on-orbit attitude control. It is a zero-momentum system consisting of reaction wheels and Earth, Sun, and inertial reference sensors. In the ADACS attitude control mode, the Earth Sensor Assembly (ESA), Sun Sensors? and the rare derived by the IMU furnish the primary attitude reference. ADACS requires ephemeris data for orbital operation. Normally, the-ephemeris data requirement can be satisfied with a ground update once per week. ADACS is autonomous, including the capability for Earth acquisition and reacquisition. The IMU will furnish a navigation reference from launch until orbit insertion, and closed-loop guidance for all spacecraft maneuvers following separation from the launch vehicle.

i

DATA HANDLING SUBSYSTEM

The Data Handling Subsystem (DHS) collects, formats, averages, and stores baseband data from other spacecraft subsystems to output baseband data to other subsystems and provide synchronous signals and clocks to other spacecraft subsystems Refer to the tables on pages 1420.1 and 1420.2.

The DHS consists of a low-rate instrument and housekeeping telemetry TIROS information Processor (TIP); AMSU Information Processor (AIP); high-rate Manipulated Information Rate Processor (MIRP); five Digital Tape Recorders (DTR); and a Cross Strap Unit (XSU) which routes data between DTR's and the processors, and between each of the communications subsystem transmitters.

The TIP, AIP, and MIRP data formats are as follows:

a. TIP Data. During routine on-orbit operations, TIP output contains low-rate instrument data multiplexed with spacecraft housekeeping data. This data is available in real time and as stored dsn. TIP outputs the following modes:

(1) Boost Mode is used for special telemetry requirements during launch and ascent.

(2) Normal Mode contains low-rate instrument and housekeeping data.

(3) Dwell Mode is used for continuously monitoring of a single telemetry point.

(4) Dump Mode is used for outputting spacecraft computer memory contents following a memory load.

TIP input data are multiplexed into a format determined by a program stored in TIP-internal Read-only Memory (ROM).

9. Description

b. AIP Data. AIP will accept sensor data from the three AMSU's and send it to the MIRP for inclusion in the Global Area Coverage (GAC), Local Area Coverage (LAC), and High-resolution Picture Transmission (HRPT) formats. AIP will also accept (TIP) data and multiplex it with AMSU data to form a 16.64-kb/sec data stream.

c. MIRP Data. MIRP generates four formats (GAC, LAC, HRPT, and Automatic Picture Transmission [APT]). MIRP incorporates algorithms for data processing and compression. contains large multi-access buffer stores which time average the intermittent AVHRR Earth scan input (for the purpose of bandwidth reduction), and manipulates the AVHRR signals with the TIP and AIP data into the desired digital formats.

1. PAGE TITLE: Spacecraft/Payload Drawing		2. REPLACES	3. PAGE NO: 1322
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO. UPN 615-3	8. REV.NO.

9. Drawing

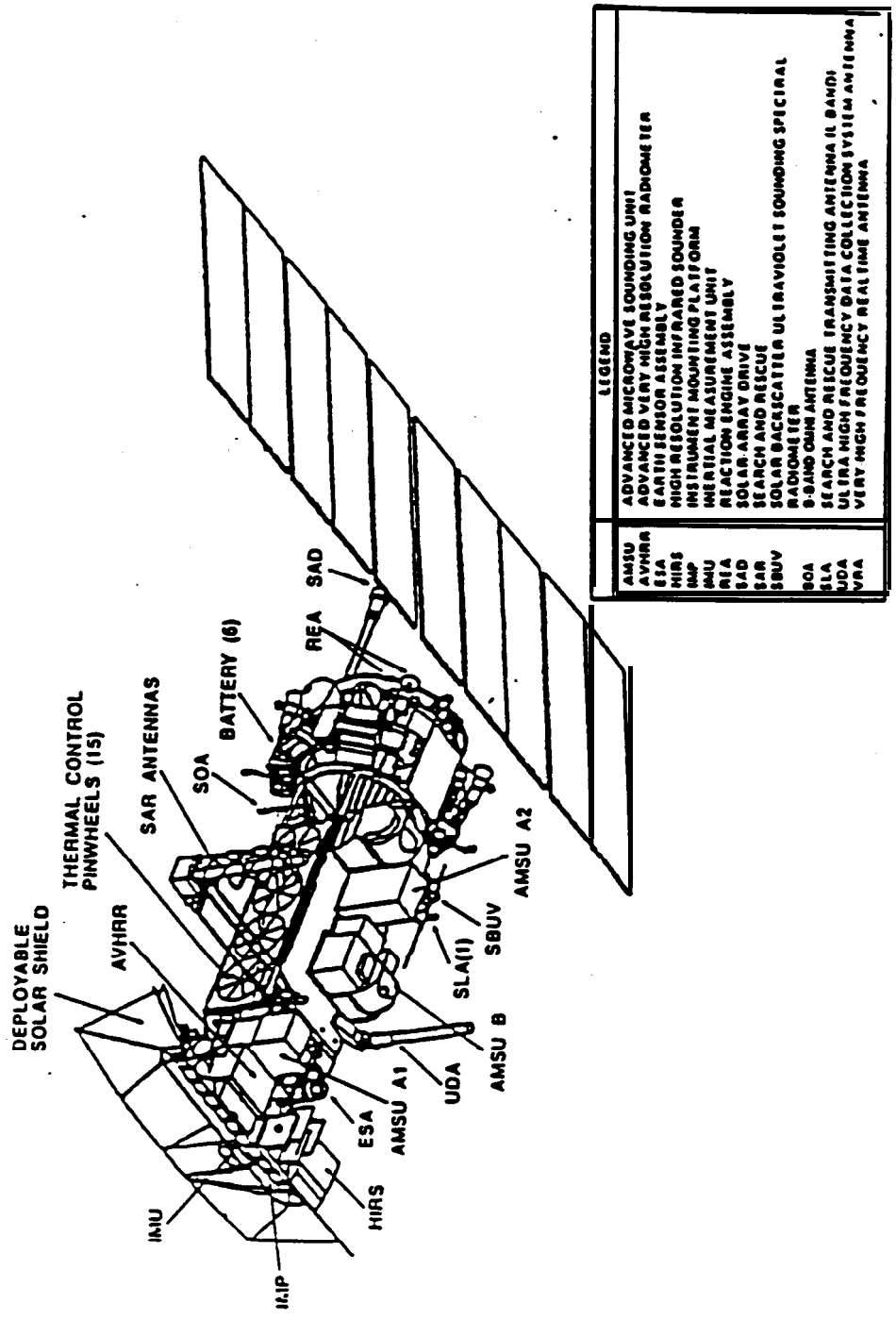

Figure 1-5. NOAA-K, -L, and -M Spacecraft Configuration

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1. PAGE TITLE: Frequency Utilization Summary		2. REPLACES	3. PAGE NO: 1405
		DATED: 4	DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO. UPN 615-3	8. REV. NO.

9. Frequency

a. **Downlink Frequencies**

S-band (MHz)

1698.0, HRPT/GAC/LAC
1702.5, HRPT/GAC/LAC
1707.0, HRPT/GAC/LAC
2247.5, Launch/Emergency

L-band (MHz)

1544.5, SARR

VHF (MHz)

137.35, TIP
137.50, APT
137.62, APT
137.77, TIP

b. **Uplink** Frequencies

S-band (MHz)

2025.0, Command

UHF (MHz)

243, SARR
401.650, DCS
406.025, SARP
406.050, SARR

VHF (MHz)

121.5, SARR

1. PAGE TITLE: Spacecraft/Payload Telemetry Systems Description		2. REPLACES	3. PAGE NO: 1420
		DATED:	4. DATE - 1 9 9 3
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO. UPN 615-3	8. REV. NO.

9. Description

DHS uses nine separate transmission links to handle communications between ground stations DHS collects, formats, and stores data from spacecraft subsystems and outputs data to other subsystems. Refer to pages 1420.2 and 2005.

a. TIP

(1) Flexible low-rate data formatter and telemetry processor.

(2) Boost, orbit, and dwell modes.

(3) 8.320 kb/sec (orbit).

(4) 16.640 kb/sec (boost).

b. Beacon.

c. APT. Automatic Picture Transmission

d. High-resolution Picture Transmission (HRPT).

e. Stored data/MIRP.

(1) High-rate data formatter and processor.

(2) Multiplexing. formatting, resolution reduction, and geometric correction functions.

(3) Analog Automatic Picture Transmission (APT), GAC data, HRPT data, LAC data outputs.

f. AIP

(1) AMSU-Al.

(2) AMSU-A2.

(3) AMSU-B.

9. Description

NOAA-K, -L, and -M DHS Inputs

Data Name	Data Source	First Data Handling Component Receiving the Data	Data Characteristics
Analog Telemetry	All active electronic components on the spacecraft on 512 separate channels	TIP	Analog health-monitor voltage on a dedicated wire per quantity.
Digital-B Telemetry	All active electronic components on the spacecraft on 352 separate channels	TIP	Bilevel status voltage on a dedicated wire per quantity.
CPU Telemetry-Boost Mode	CIU	TIP	NRZ-L data per a specified handshake at 8,000 b/sec.
CPU Telemetry - Orbit Mode	CIU	TIP	NRZ-L data per a specified handshake at 960 b/sec.
Command Verification Data	CIU	TIP	NRZ-L data per a specified handshake. One 16-word per 0.05 second (Boost Mode) or 0.1 second (Orbit Mode).
Digital-A Data	All government-furnished instruments except AVHRR. SARR. SARI', and AMSU. (16 channels; 4 used)	TIP	NRZ-L data per a specified handshake in multiplex of 8 bits per 0.1 second; not accepted in TIP Boost or Dwell Modes
AVHRR Data	AVHRR	MIRP	NRZ-L data per a specified handshake in bums at 1.9968 Mb/sec averaging to 0.62 13 Mb/sec.
AMSU Data	AMSU-Al, A2, and B	AIP	NRZ-L data per a specified handshake. Twenty-five 8-bit words from AMSU-Al, 13 S-bit words from AMSU-AZ. and 50 S-bit words from AMSU-B per 0.1 second. Not intended for TIP Boost or Dwell Modes.

1. PAGE TITLE: Spacecraft/Payload Telemetry Systems Description		2. REPLACES	3. PAGE NO: 1420.2
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K. -L. AND -M	7. PROGRAM NO. UPN 615-3	8. REV. NO.

9. Description

NOAA-K -L, and -M DHS Outputs

Data Name	Real-time or Playback	Destination	Conditions	Data Characteristics
TIP Orbit	Real-time	Both BTX's	TIP in Orbit Mode	8320 b/sec split phase
TIP Orbit	Real-time	STX-2 or -4	TIP in Orbit Mode Command to XSU Command to AIP	8320 b/sec split phase
TIP Boost	Real-time	STX-2 or -4	TIP in Boost Mode Command to XSU Command to AIP	16,640 b/sec split phase
HRPT	Real-time	STX-1, -2, or -3	MIRP on command to XSU	665.4 kb/sec split phase
APT	Real-time	Both VHR Real-time Transmitters (VTX)	MIRP on	AM 2400-Hz subcarrier
TIP Orbit	Playback	STX-1. -2. or -3	Command to XSU	332.7 kb/sec split phase
TIP Boost	Playback	STX-1, -2. or -3	Command XSU	332.7 kb/sec split phase
GAC	Playback	STX-1, -2, or -3	MIRP on command to xsu	2.66 16 Mb/sec NRZ or 1.3308 Mb/sec split phase
LAC	Playback	STX-I, -2, -3	MIRP on command to xsu	2.66 16 Mb/sec NRZ or 1.3308 Mb/sec split phase
TIP Subcom Data	Real-time	CIU	CIU responds to handshake	64 bits per TIP minor frame-in bursts
AMSU/TIP	Playback	STX-1, -2, or -3	TIP in Orbit Mode Command to XSU	16,640 b/sec split phase
AMSU/TIP	Real-time	STX-1, -2, or -3	TIP in Orbit Mode Command to XSU	16,640 b/&c split phase

1. PAGE TITLE: Spacecraft/Payload Telecommunications Systems Parameters - Telemetry		2. REPLACES	3. PAGE NO: 1421
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO. UPN 615-3	8. REV. NO.

9. Description

a. Telemetry Launch and Contingency - 2247.5 MHz

(1) Transmitter:

Bandwidth	3 MHz
Power	5.25 watts
Modulation	PM±67 degrees peak (BPSK)

(2) Antenna:

Frequency Range	2237.0 to 2257.0 MHz
Tuning	Fixed
Polarization	Right Circular Polarization (RCP)/RCP
Gain	95 percent of sphen >- 18 dBci
Beamwidth	OMNI
Transmission Losses	2.0 dB
Pattern (basic)	Two hemispheres

(3) Modulation:

Type	Split Phase PCM/BPSK
No. of Channels	One
Bit Rate	16.64 kb/sec (TIP boost) 8.32 kb/sec (TIP orbit) 16.64 kb/sec (AIP)

b. Telemetry Data Transmitters (three) - 1698, 1702.5, 1707 MHz

(1) Transmitter:

Bandwidth	3 MHz
Power (each mode)	6.35 watts
Modulation	PM ±67 degrees peak

(2) Antenna:

Frequency Range	1695 to 1710 MHz
Polarization	RCP or Left Circular Polarization (LCP)
Gain	2.1 dBi/minimum at 63 degrees
Beamwidth	63 degrees half-angle cone
Transmission Losses	2.0 dB
Pattern (basic)	Dimpled cardioid

(3) Modulation:

Type	Non-return to Zero (NRZ) or Split Phase (BiO-L)
No. of Channels	One per transmitter
Commutation	Fixed TDM

9. Description

c. Tracking System and Medium Rate Beacon 137.35 or 137.77 MHz (Telemetry)

(1) Transmitter:

Bandwidth	30 kHz (with Doppler)
Power (each mode)	1 watt
Modulation	PM ±67 degrees peak

(2) Antenna:

Frequency Range	136to 138 MHz
Polarization	Linear
Gain	-6 dBi/minimum at 63 degrees
Beamwidth	±50 degrees
Transmission Losses	2.0 dB
Pattern (basic)	Torroid

(3) Modulation:

Type	Split Phase
No. of Channels	One direct PCM
Commutation	6 of 104 words per minor frame are subcommutated (8.32 kb/sec in orbit mode)

9. Description

COMMAND AND CONTROL SUBSYSTEM

The Command and Control Subsystem (CCS) accepts formatted (encrypted or clear) command data from the ground on the 2025.0-MHz S-band uplink, and receives signals and data from other spacecraft subsystems and decodes them for use. CCS generates timing and control signals for itself and other subsystems for performing various spacecraft functions

CCS accepts formatted commands and data to perform required guidance and attitude control computations, and provides data, command, and control management functions for all subsystems in the Central Processing Unit (CPU) that are part of the CCS. The CPU's provide status and parameter values for telemetry in conjunction with their functions. CCS contains the following major items:

a CPU. Each of the two CPU's contains the main spacecmft memory and processing subunits, and provides flexible data processing and computational capabilities to support all spacecraft subsystems.

b. Controls Interface Unit. The Controls Interface Unit (CIU) is the central element of the CCS, handling both the interfaces between units within the CCS and the remainder of the spacecraft The CIU decodes messages, provides control signals to the spacecraft, and provides clock frequencies to the CCS and the rest of the spacecraft, as required.

c. Redundant Crystal Oscillator. The Redundant Crystal Oscillator (RXO) consists of two independent, oven-controlled 5. 12-MHz crystal oscillators, one of which is selected as the oscillator source for the CIU frequency division chain.

d. Signal Conditioning Unit. High-current control signals are supplied to spacecraft units by the Signal Conditioning Unit (SCU) in response to low-level control signals from the CIU. Interfacing that cannot be accomplished directly by the CIU is performed through the SCU.

e. Controls Interface Unit. The Controls Interface Unit (CXU) is a redundant extension of the CIU, and is used to augment the number of discrete control signals available to the rest of the spacecraft

f. Decryption and Authentication Unit. The Decryption and Authentication Unit (DAU) is a redundant unit that interfaces with the receiver demodulator, pmvides decryption and authentication of uplink commands, and transmits valid uplink commands to the CIU for processing.

g. Flight Software. The flight software resides in each of the two CPU's, and includes command and control, attitude control for orbit and ascent modes, and executive software.

The CCS receives real-time commands and data from the ground stations through the Gmund Receiver/Demodulator (GRD). Commands received in real time are executed immediately. Commands received as part of the stored command table load are executed at a later time.

1. PAGE TITLE: Spacecraft/Payload Command Systems Description		2. REPLACES	3. PAGE NO: 1430.1
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO. UPN 615-3	8. REV. NO.

9. Description

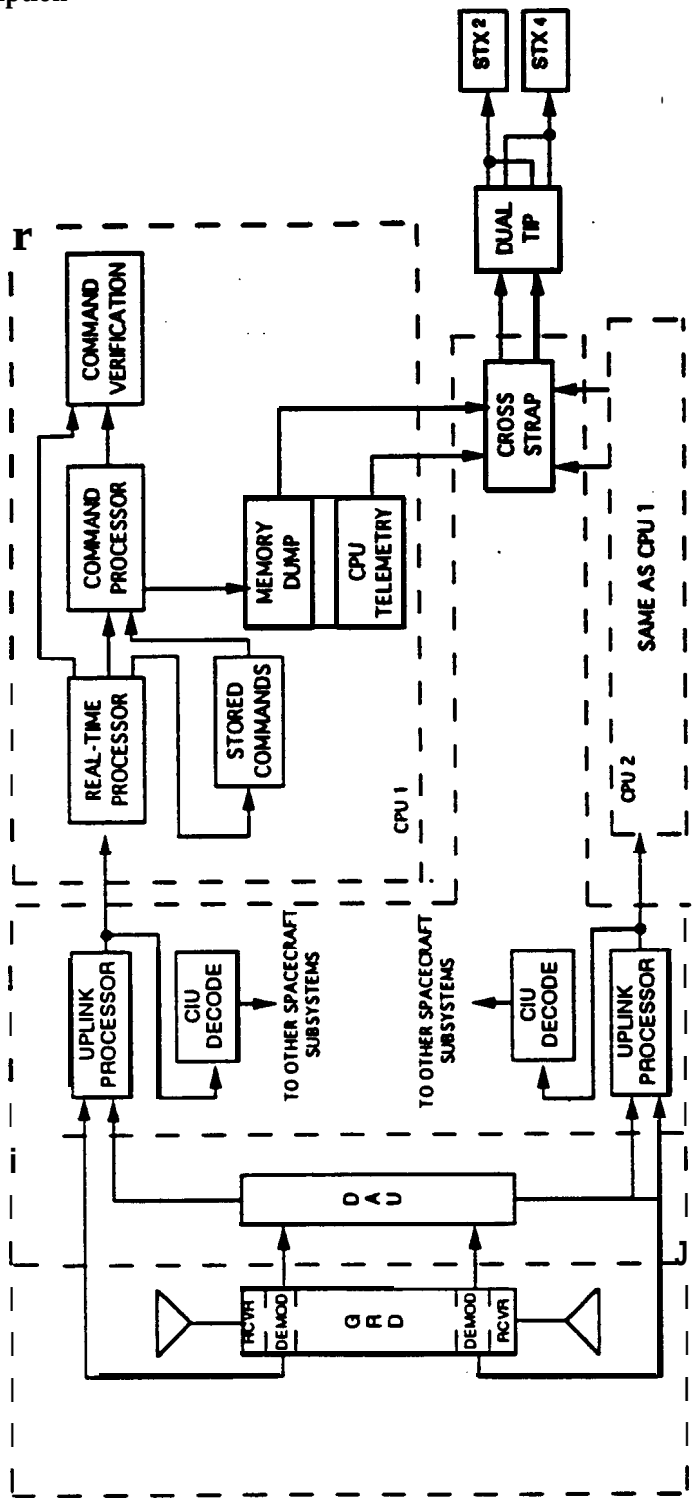

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Figure 1-6. Command and Control Subsystem

1. PAGE TITLE: Spacecraft/Payload Telecommunications System Parameters - Command		2. REPLACES	3. PAGE NO: 1431
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	9. PROGRAM NO. UPN 615-3	8. REV. NO.

9. Description

Parameter	Value
Carrier Frequency	2025 ±0.061 MHZ
Modulation Index	1.0 Rad
Sensitivity for BER=10^{-6}	-118 dBm
Receiver Sensitivity	-127 dBm (approximately)
Noise Figure (maximum)	6.0 dB
Preselector Bandwidth 3 dB	25 MHz, maximum
Acquisition Time (Carrier)	9.0 seconds maximum
Deactivation Time	50 ms, maximum
Carrier Modulation	PM
Modulating Waveform	Squarewave
Subcarrier Frequency	16.0 kHz
Command Bit Rate	2 kb/sec

1. PAGE TITLE: Launch Vehicle Major Mission Events		2. REPLACES	3. PAGE NO: 1710
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO. UPN 615-3	8. REV. NO.

9. Drawing

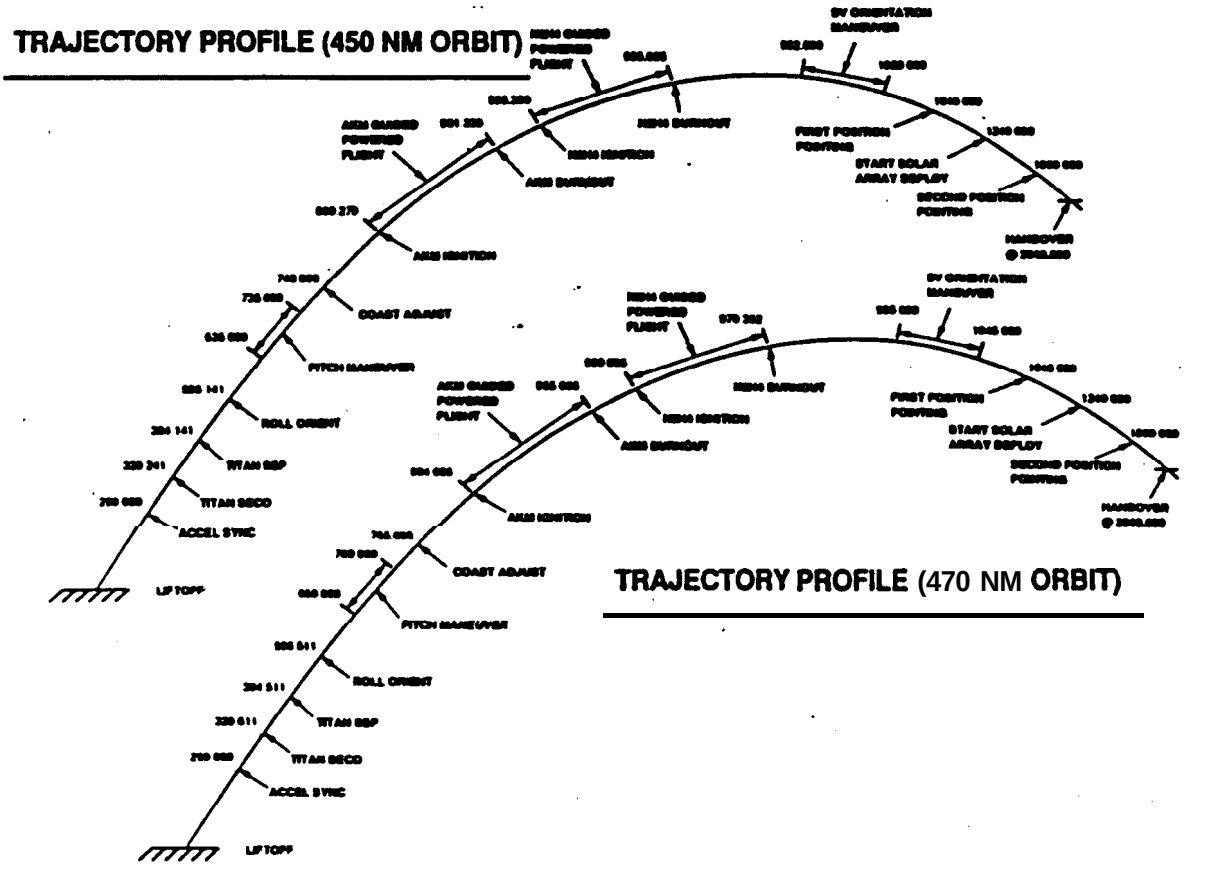


Figure 1-7. Sequence of Events

1. PAGE TITLE: Launch Vehicle Plight Sequence - Mark Events		2. REPLACES	3. PAGE NO: 1711.2
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K. -L. AND -M	7. PROGRAM NO. UPN 615-3	8. REV. NO.

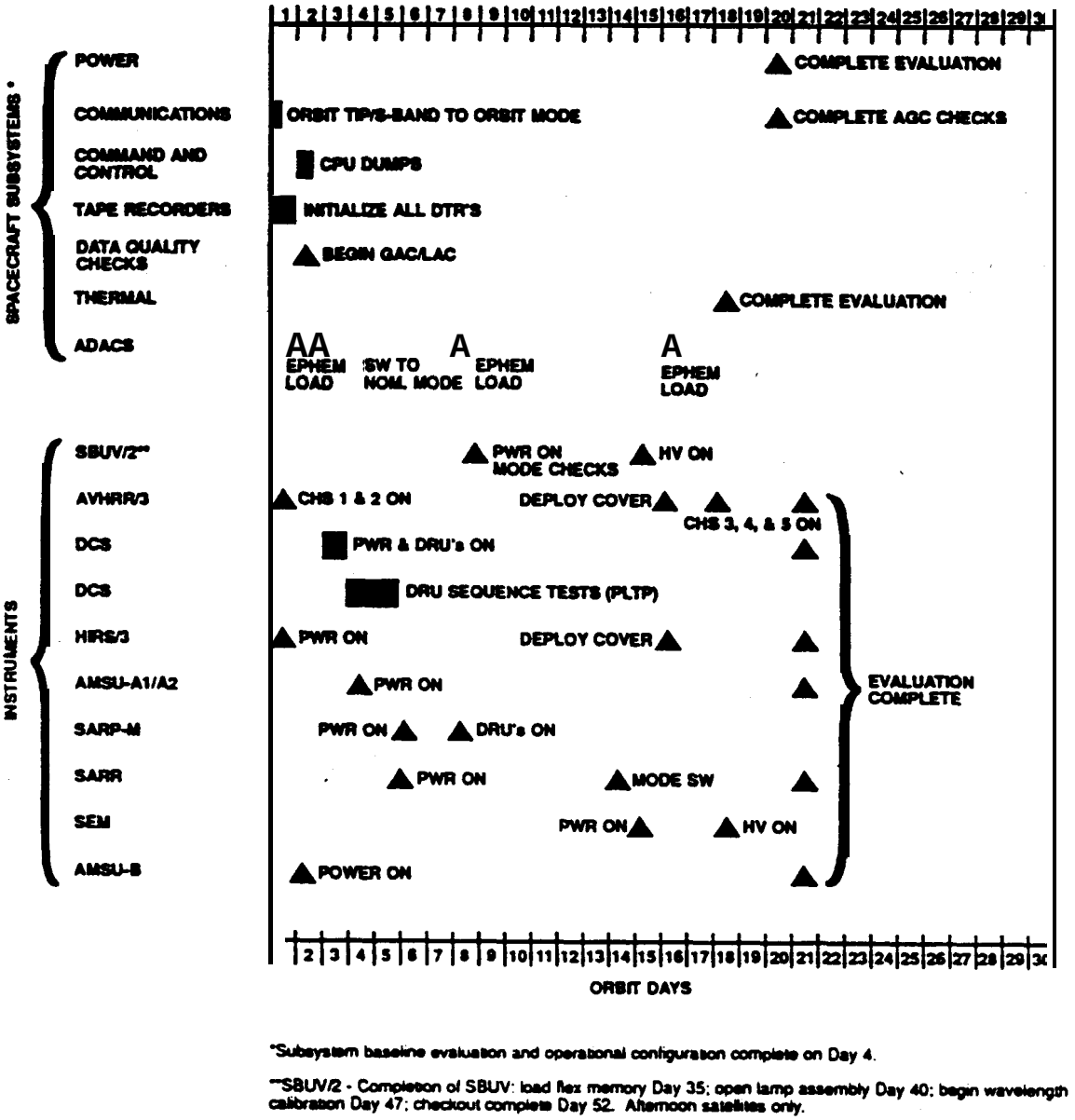
9. Description

Sequence of Events (cont)

Range Time		Event	Initiated By
450 NM in seconds from lift-Off	470 NM in seconds from lift-Off		
1990.0	1990.0	Stop Position Pointing Guidance N2 P/Y Control Fine DZ	AGS Guide Mode AGS Cont. Seq.
2039.0	2039.0	Deactivate Controls	AGS Cont. Seq.
2040.0	2040.0	Handover	AGS DW1 Bit 14 On

1. PAGE TITLE: Spacecraft/Payload Major Mission Events		2. REPLACES	3. PAGE NO: 1715
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO. UPN 615-3	8. REV. NO.

9. Drawing



*Subsystem baseline evaluation and operational configuration complete on Day 4.

**SBUV/2 - Completion of SBUV: load flex memory Day 35; open lamp assembly Day 40; begin wavelength calibration Day 47; checkout complete Day 52. Afternoon satellites only.

Figure 1-8. NOAA Activation and Evaluation Tiiclinc (Typical)

1. PAGE TITLE: Launch Vehicle Trajectory Data		2. REPLACES	3. PAGE NO: 1720
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOM-L-L, AND -M	7. PROGRAM NO. UPN 615-3	8. REV. NO.

9. Description

a. Injection Position

(1) ATN 450-nmi Orbit:

Latitude	6.056 degrees (South)
Longitude	229.424 degrees
Radius	7200.85 km

(2) ATN 470-nmi Orbit:

Latitude	7.1346 degrees (South)
Longitude	229.022 degrees
Radius	7237.89 km

b. Injection Velocity

(1) ATN 450-nmi Orbit:

Plight Path Azimuth	188.74 degrees
Flight Path Elevation	0 degrees
Velocity	7.44 km/sec

(2) ATN 470-nmi Orbit:

Flight Path Azimuth	188.9247 degrees
Flight Path Elevation	0 degrees
Velocity	7.4210 km/sec

c. Time of Injection

(1) ATN 450-nmi Orbit	Liftoff plus 955.625 seconds
(2) ATN 470-nmi Orbit	Liftoff plus 979.352 seconds

Note

This data is preliminary and will be updated as it becomes available.

1. PAGE TITLE: Spacecraft/Payload Orbital Parameters		2. REPLACES	3. PAGE NO: 1725
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO. UPN 615-3	8. REV. NO.

9. Description

The following NOAA-K, -L, and -M missions orbits are based on an Earth radius of 6378.135 km:

a. 450-nmi Orbit:

Semi-major axis	7200.85 km
Eccentricity	0.1688-07
Inclination	98.6 degrees
Argument of Perigee	8.906 degrees
RA of Ascending Node	f (launch time degrees)
Anomalistic Period	101.3527 minutes
Height of Perigee	823.218 km
Height of Apogee	823.218 km
Change in Orbital Elements:	
Perigee Rate	-2.88 degrees per day
Node Rate	0.98 degrees/day
Period	Fixed

b. 470-nmi Orbit:

Semi-major axis	7237.89 km
Eccentricity	2.7407 15-08
inclination	98.856 degrees
Argument of Perigee	185.062 degrees
RA of Ascending Node	f (launch time degrees)
Anomalistic Period	102.1357 minutes
Height of Perigee	859.92 km
Height of Apogee	859.92 km
Change in Orbital Elements:	
Perigee Rate	-2.86 degrees per day
Node Rate	0.98 degrees per day
Period	Fixed

Note

This data is preliminary and will be updated as it becomes available.

1. PAGE TITLE: Radio Frequency (RF) Telecommunications Requirements		2. REPLACES	3. PAGE NO: 2000
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

System Elements

Flight Segment: The flight segment will include the spacecraft bus, its support subsystems. the operational instruments, and the propulsion systems required to transfer the spacecraft from polar transfer orbit to its final orbit

Launch Ground Segment; The launch ground segment will include the Vandenberg Air Force Base (VAFB)/Western Range (WR); the Deep Space Network (DSN), operated by the Jet Propulsion Laboratory (JPL); Air Force Satellite Control Network (AFSCN), GSFC Network Control Center (NCC), Flight Dynamics Facility (FDF), and the NOAA on-orbit ground segment See Figure 2- 1.

Operations Ground Segment: The operations ground segment will consist, primarily, of the NOAA Satellite Operations Control Center (SOCC) for satellite control, the NOAA Command and Data Acquisition (CDA) stations for supporting spacecraft operations, and the NOM Central Data and Distribution Facility (CDDF) for data processing and dissemination.

Data Products: All operational data products required for postlaunch checkout and NOAA operations will be the responsibility of NOAA and will be developed and disseminated by NOM's CDDF at the World Weather Building in Camp Springs, Maryland, and the Environmental Research Laboratory in Boulder, Colorado.

Facility Characteristics: Existing NOM facilities will be employed for on-orbit operations. Existing NASA and Air Force facilities at the WR will be used for launch operations.

10. Response
No issues identified.

1. PAGE TITLE: Radio Frequency (RF) Telecommunications Requirements		2. REPLACES	3. PAGE NO: 2000.2
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

Activation and Evaluation (A&E) Mission Phase

Upon the successful completion of sun-synchronous orbit at one of the two altitudes, (refer to page 17 10) NASA's Metsat Project will conduct the activation and evaluation of S/C systems and the operation evaluation of each spacecraft. This will be accomplished by a Project team at the NOAA/SOCC. During the A&E period, which is expected to last 21 days, the Project team will work with NOAA to control the satellite and process and analyze satellite data necessary for evaluation. The DSN and NOM CDA stations will be scheduled to support telemetry and command activities, and AFSCN/RTS's if required to support the telemetry S-band downlink. C-band tracking data, from USSPACECOM skin trackers, is used for orbit determination and generation of S-band station acquisition data by the FDF. On successful activation and elevation, the spacecraft will be turned over to NOM for routine operations (nominally at launch plus 21 days).

Mission Operations

Centralized remote control of the NOAA-K, -L, and -M satellite will be through the CDA stations, by the NESDIS/SOCC. The ground system is made up of PACS and the central processing system. designated the Central Environmental Satellite Computer System (CEMSCS). The CDA stations transmit command programming to the satellite and acquire and record meteorological and engineering data from the satellite. USSPACECOM has prime responsibility for trajectory support, which includes establishing the initial orbit solution and providing updated orbital parameters routinely throughout the life of the mission. USSPACECOM provides the orbit information through communication to NOAA/SOCC. All ground attitude determination is accomplished by the NOAA central data processing facility.

10. Response

No exceptions identified.

1. PAGE TITLE: Radio Frequency (RF) Telecommunications-Summary Tables		2. REPLACES	3. PAGE NO: 2005.1
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

Frequency Utilization Summary (Uplink)

Label	RCV (MHz)	Data Rate	Modulation	Coding	Purpose
S/C CMD	2025.00	2.0 kb/sec	PSK (16 kHz SCO)	NRZ-M	S/C Commanding via 32-bit plain text or 64-bit cipher text
*SAR	VHF/UHF				Emergency/Distress signal monitor
*DCS	UHF				Data Collection Platform Signals

*No support requirements exist per this DMR.

Data Types Table

Label	source	Destination	Data Rate	Channel Identifier	Purpose
TLM Launch Mode (2247.5 MHz)	Ground Station	NOAA-SOCC	16.64 kb/sec 8.32 kb/sec (Nascom Blocks [note])	Boost orbit	Receive, record, and relay TIP data in real time to the SOCC
CMD (2025.0 MHz)	NOAA-SOCC	Ground Station	2.0 kb/sec (Nascom Blocks [note])	S/C CMD	Commands to the S/C

Note: 4800-bit DSN/GSFC Interface Blocks (DGIB) blocked from/to DSN.
The stations transmit full data blocks (no till data) to the NOAA/SOCC.

10. Response
No exceptions identified.

1. PAGE TITLE: Radio Frequency (RF) Telecommunications Requirements		2. REPLACES	3. PAGE NO: 2000.
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

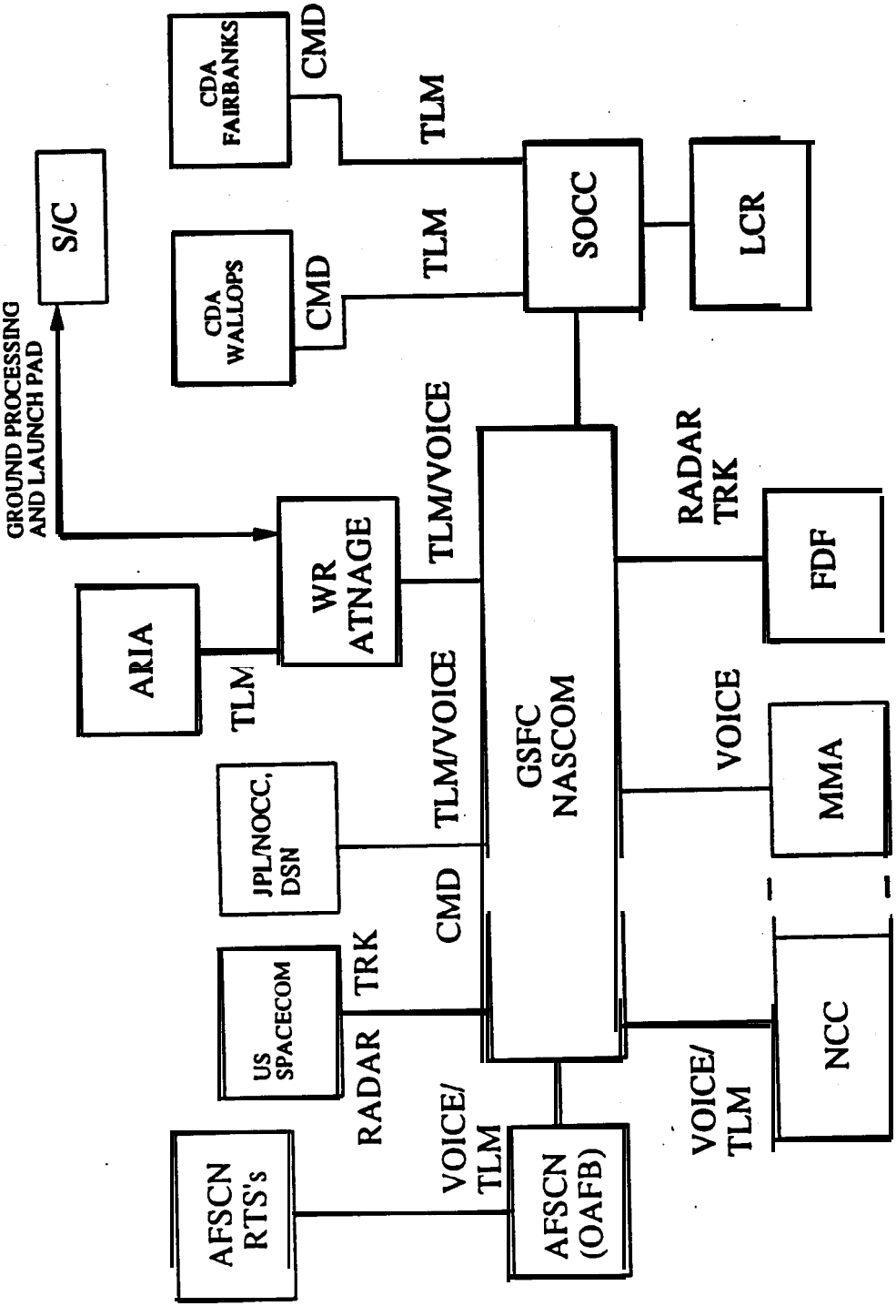


Figure 2-1. Supporting Ground Network

A0266

1. PAGE TITLE: Radio Frequency (RF) Telecommunications-Summary Tables		2. REPLACES	3. PAGE NO: 2005
		DATED: 4.	DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

Frequency Utilization Summary (Downlink)

Label	XMIT (MHz)	Data Rate	Modulation	Coding	Purpose
STX1	1698.00	(Note 1)	PSK/PM	NRZ-L or BiO-L	Meteorological S-band HRPT/GAC/LAC
STX2	1702.50	(Note 1)	PSK/PM	NRZ-L or BiO-L	Meteorological S-band HRPT/GAC/LAC
STX3	1707.00	(Note 1)	PSK/PM	NRZ-L or BiO-L	Meteorological S-band HRPT/GAC/LAC
STX4 (Note 2)	2247.50	16.64 kb/sec 8.32 kb/sec	BPSK	BiO-L	Boost or Orbit Mode (S-band)
VTX1	137.50	Subcarrier 2.4 kHz	AM/FM	-	MIRP Ancillary Data
VTX2	137.62	Subcarrier 2.4 kHz	AM/FM	-	MIRP Ancillary Data
BTX1	137.35	8.32 kb/sec	PSK	BiO-L	TIP Data
BTX2	137.77	8.32 kb/sec	PSK	BiO-L	TIP Data
SARR	1544.5	2.4 kb/sec plus analog	PM	BiO-L	Processed 406-MHz beacon data and unprocessed 121.5-MHz and 243.0-MHz beacon data

Note 1: 0.6654 Mb/sec, split-phase (BiO-L)
0.3327 Mb/sec, split-phase (BiO-L)
1.33 Mb/sec, split-phase (BiO-L)
2.66 16 Mb/sec, NRZ-L

Note 2: Supported by DSN and AFSCN.

10. Response
No exceptions identified.

9. Description

Environmental Data Formats

There are no significant changes in the method of mission data handling and acquisition from those developed for previous NOAA satellites, but a sixth data format is added for the Advanced Microwave Sounding Unit (AMSU) data handling. These six basic data formats are generated onboard the satellite, each associated with one or more of the acquisition modes (stored or real-time, VHF, or S-band transmissions). These formats are as follows:

TIP Data Format: TIP data is available in real time and as stored data. Real-time TIP data is available through the VHF beacon link, and will also be available from any of the four S-band transmitters. For early-orbit support and maintenance operations, the TIP has three other operating modes: boost (at 16.64 kb/sec), dwell, and satellite computer memory dump.

AMSU Information Processor (AIP) Data: Under routine mission-orbit operations, AMSU data is available as part of a low-rate data format_ This format consists of 208 8-bit words and contains both standard TIP data and AMSU sensor data. The primary use of this 16-kb/sec format will be for global recording during orbits which are blind to CDA stations. It is anticipated that AMSU data will normally be extracted from HRPT, LAC, and GAC data.

Telemetry Formats

The NOAA-K, -L, and -M telemetry formats arc shown on pages 2020.1 through 2020.5. The AIP output format (shown on page 2020.5) will only be supported by NOAA CDA stations. The TIP data formats are as follows:

a. Synchronization Code (20 bits): 3557040 octal.
b. Satellite Address: 4 bits.
c. Bits per word: 8.
d. Words per minor: 104
e. Minor frame per major frame: 320.
f. Significant bit count: MSB first.
g. Major frame period
   (1) TIP Boost Mode: 16.0 seconds (16.64 kb/sec).
   (2) TIP Orbit Mode: 32.0 seconds (8.32 kb/sec).
   (3) TIP Dump Mode: 32.0 seconds (8.32 kb/sec).
   (4) TIP Dwell Mode: 32.0 seconds (8.32 kb/sec).

IO. Response
No issues identified.

1. PAGE TITLE: Radio Frequency (RF) Telecommunications-Telemetry Structures		2. REPLACES	3. PAGE NO: 2020.1
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	a REV. NO.

9. Description

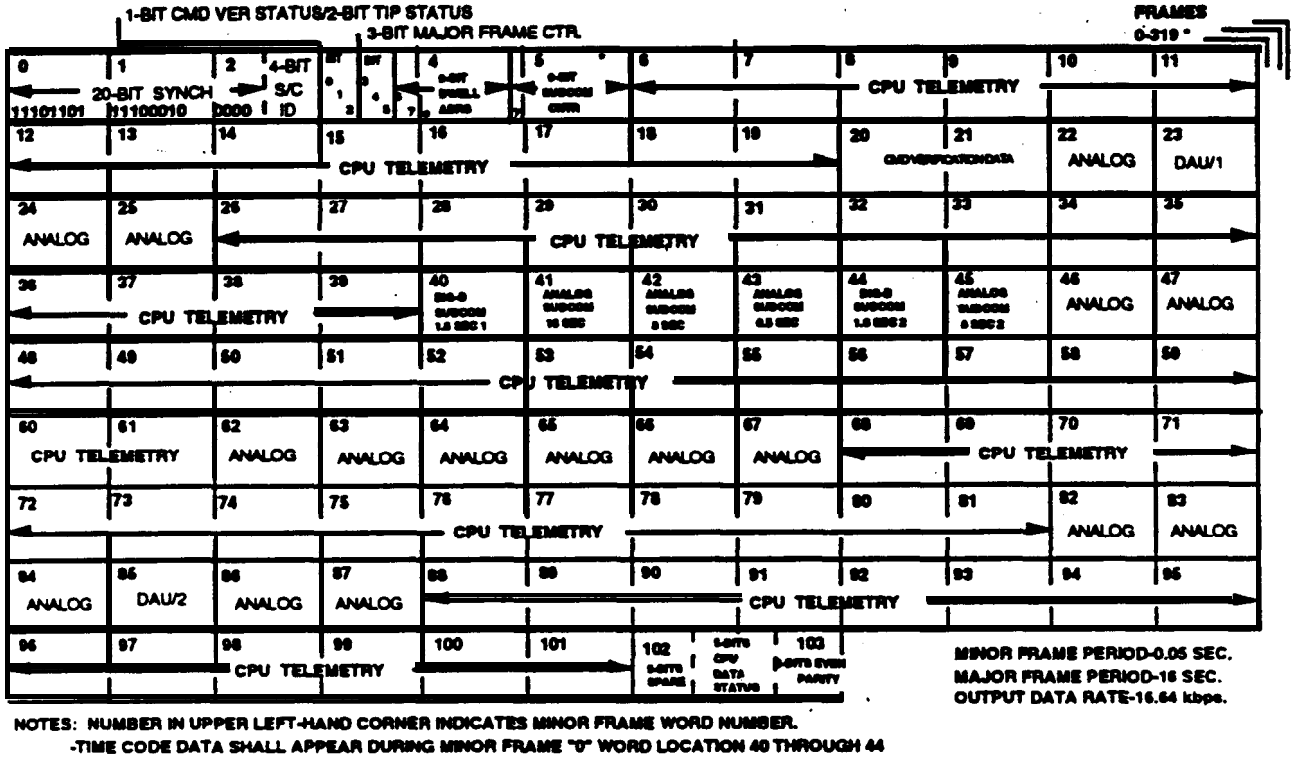
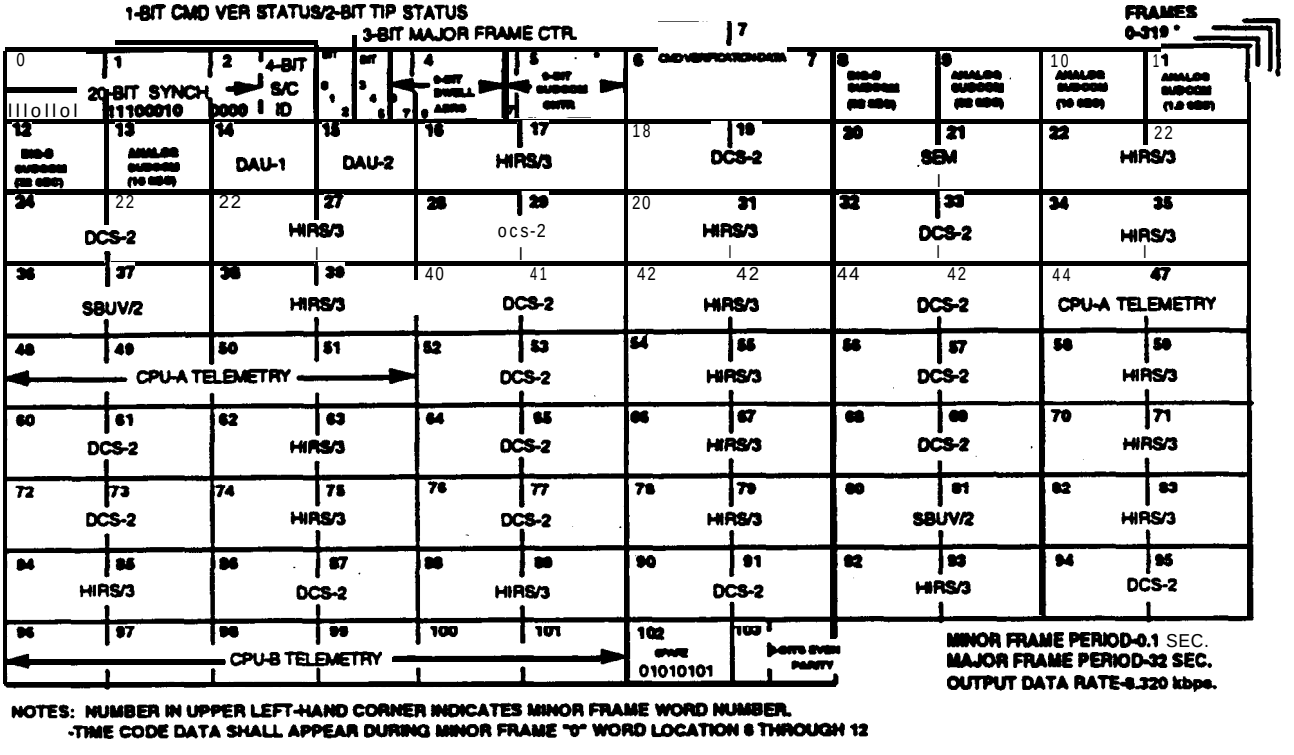


Figure 2-2. TIP Boast Mode Format for NOAA-K. -L. and -M

1. PAGE TITLE: Radio Frequency (RF) Telecommunications-Telemetry Structures		2. REPLACES	3. PAGE NO: 2020.2
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

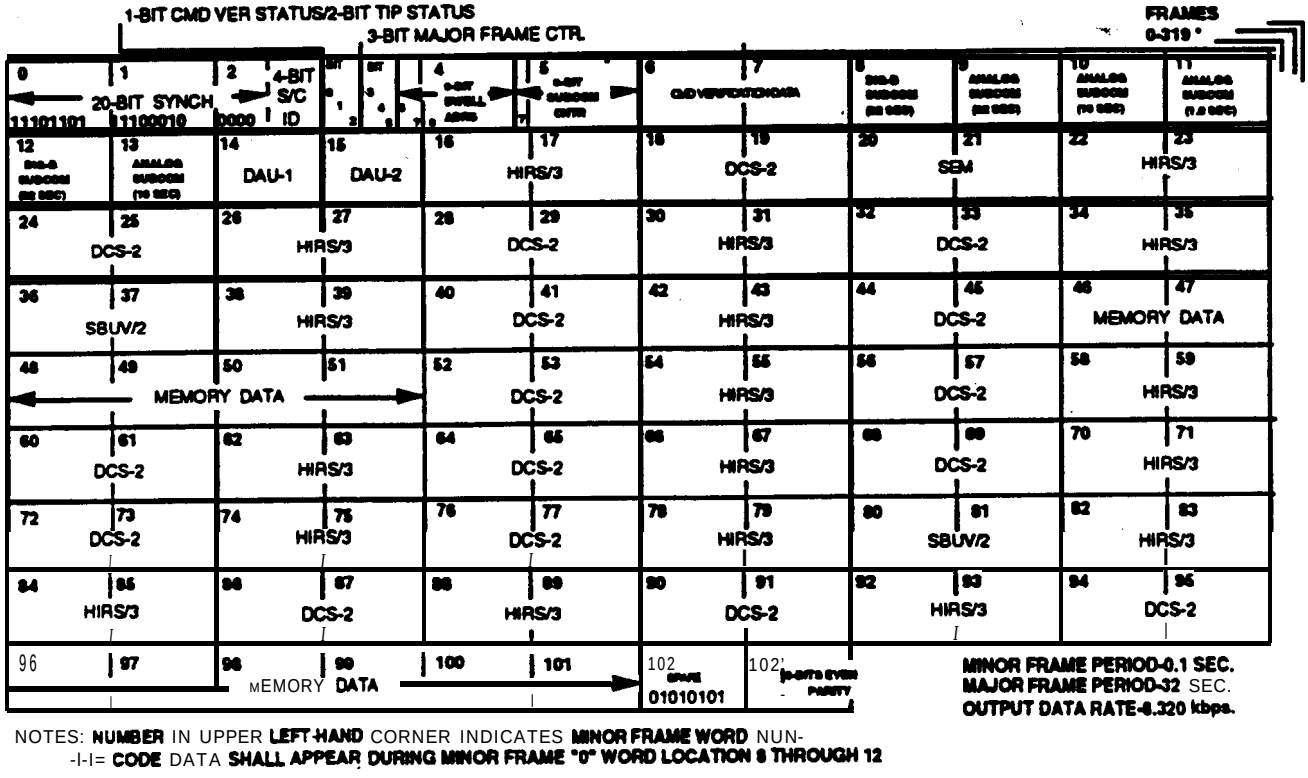


NOTES: NUMBER IN UPPER LEFT-HAND CORNER INDICATES MINOR FRAME WORD NUMBER.
-TIME CODE DATA SHALL APPEAR DURING MINOR FRAME "0" WORD LOCATION 6 THROUGH 12

Figure 2-3. TIP Orbital Mode Format for NOAA-K, -L, and -M

1. PAGE TITLE: Radio Frequency (RF) Telecommunications-Telemetry Structures		2. REPLACES	3. PAGE NO: 2020.3
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description



NOTES: NUMBER IN UPPER LEFT-HAND CORNER INDICATES MINOR FRAME WORD NUN-
-I-I= CODE DATA SHALL APPEAR DURING MINOR FRAME "0" WORD LOCATION 8 THROUGH 12

Figure 2-4. TIP Dump Mode Format for NOAA-K, -L. and -M

1. PAGE TITLE: Radio Frequency (RF) Telecommunications-Telemetry Structures		2. REPLACES	3. PAGE NO: 2020.4
		DATED:	4. DATE November1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

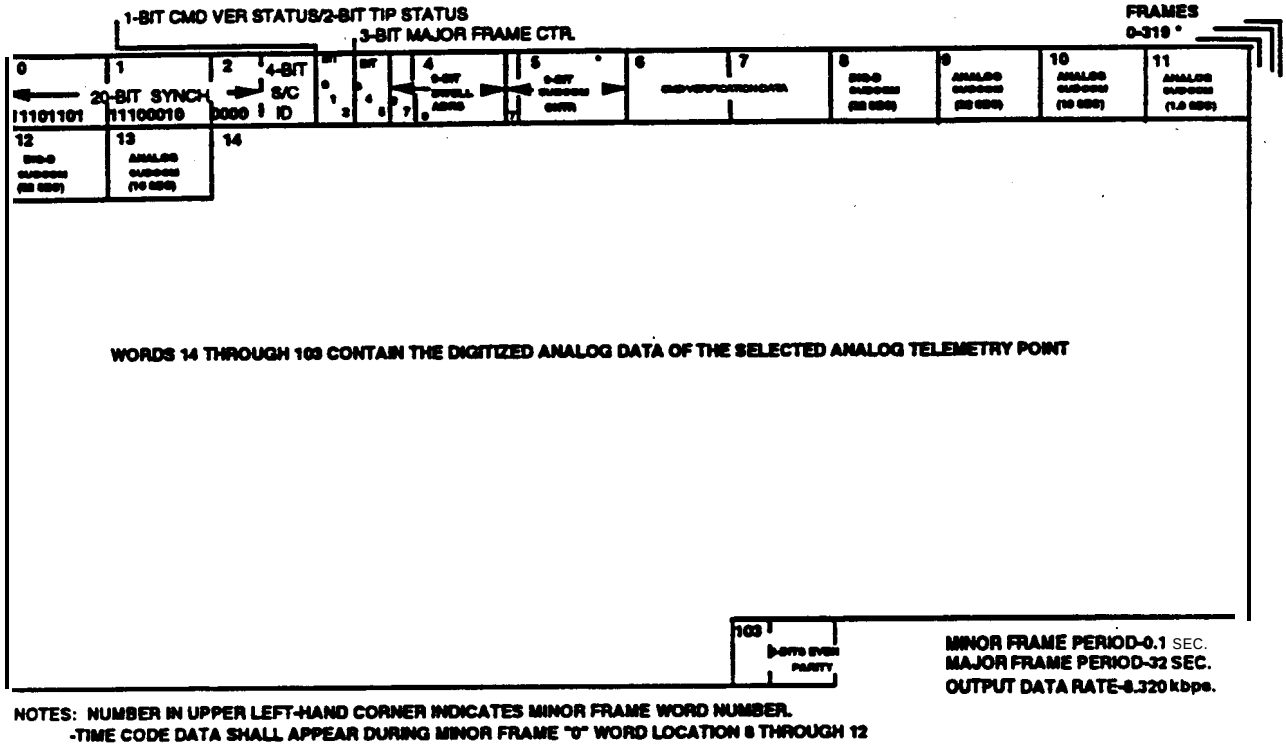


Figure 2-5. Dwell Mode

1. PAGE TITLE: Radio Frequency (RF) Telecommunications-Telemetry Structures		2. REPLACES	3. PAGE NO: 2020.4
		DATED:	4. DATE November1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

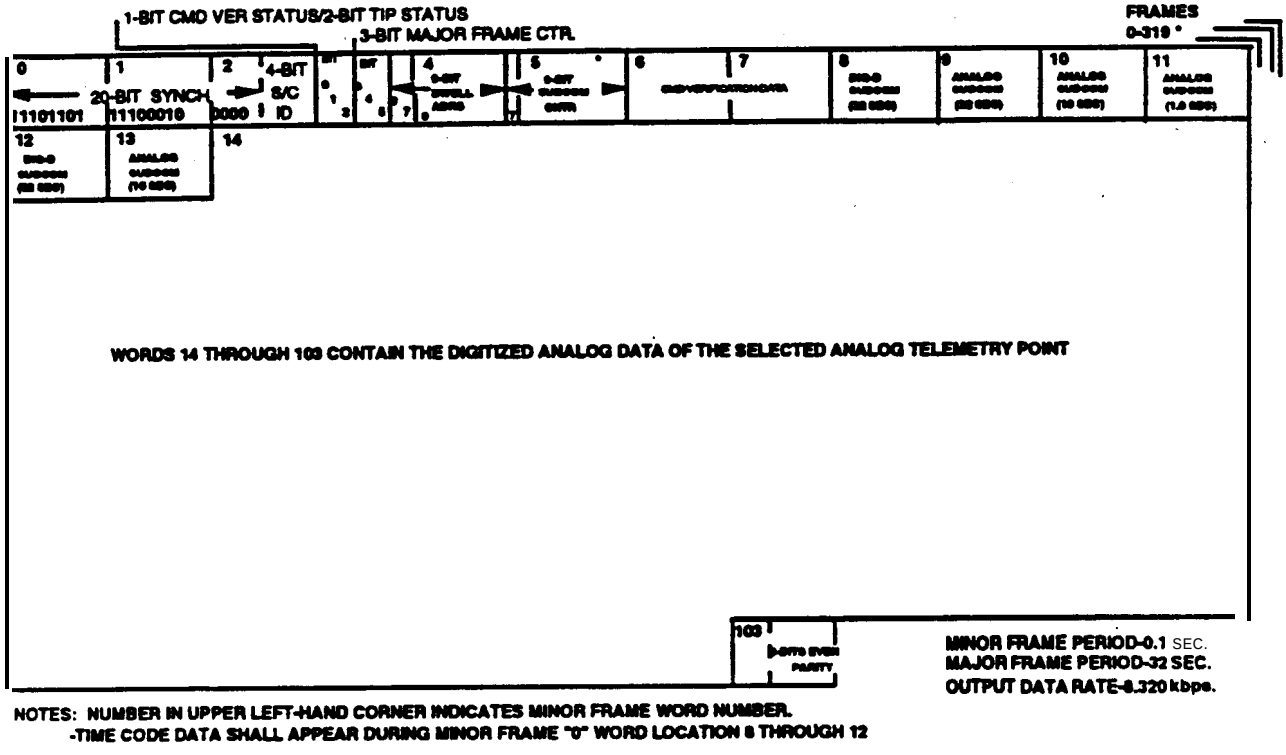


Figure 2-5. Dwell Mode

1. PAGE TITLE: Radio Frequency (RF) Telecommunications-Telemetry Structures		2. REPLACES	3. PAGE NO: 2020.5
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

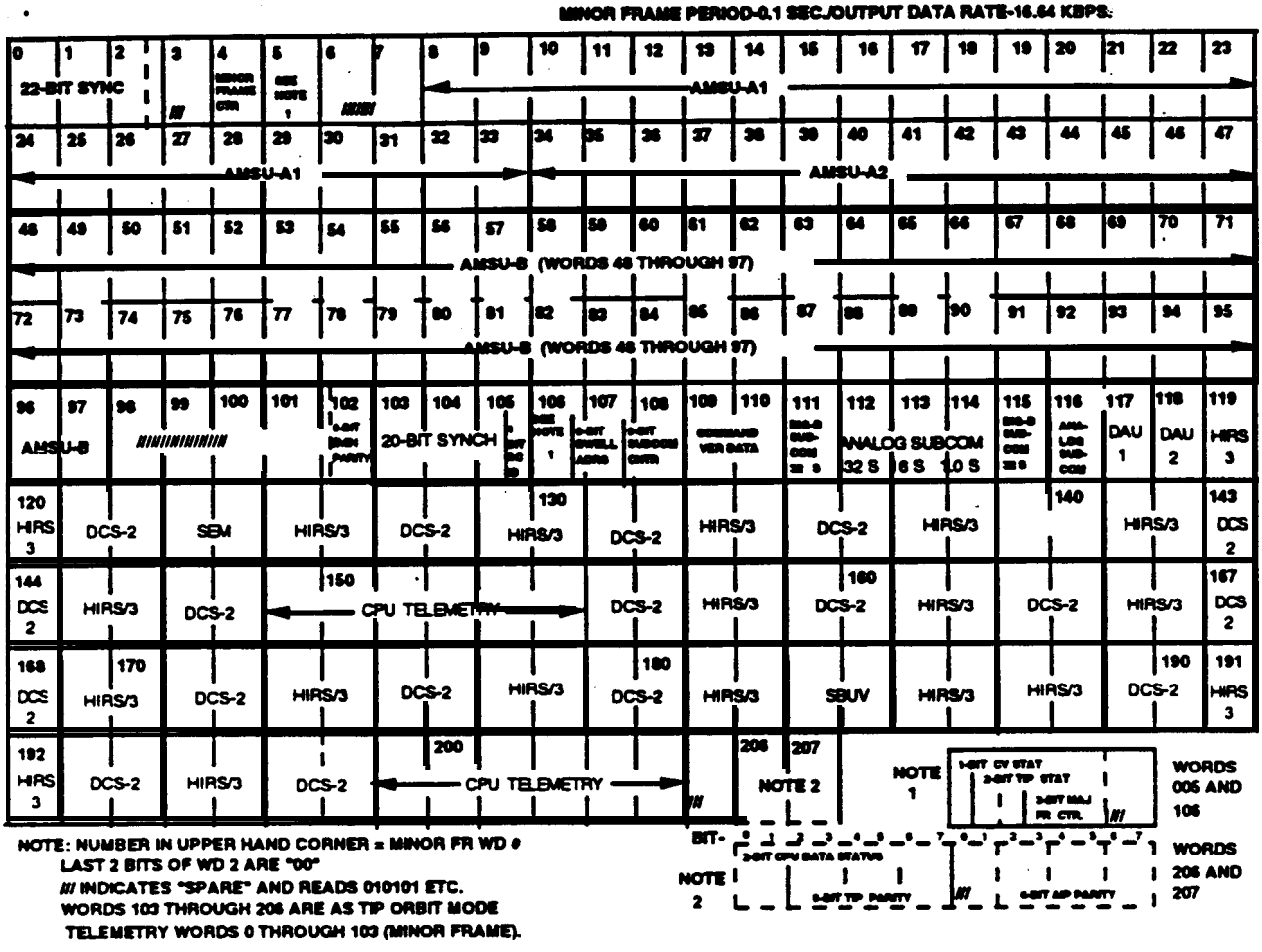


Figure 2-6. AIP Output Mode

1. PAGE TITLE: Radio Frequency (RF) Telecommunications Requirements-Command Word Structure		2. REPLACES	3. PAGE NO: 2030
		DATED:	4. DATE November1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

NOAA-K, -L, and -M is the first in a series of NOAA spacecraft to incorporate S-band commanding. A 16.0 kHz subcarrier will be used and the command stream PSK/PCM modulated. The subcarrier is PM modulated on the 2025.0 MHz uplink. The spacecraft command decoder addresses are as follows (refer to page 2030.3, satellite address field):

Satellite	*Telemetry	*Bits Hex	CMD Decoder	Hex (17)
NOAA-K	Tip 1	1000 (8)	2 0001000	(28)
NOAA-L	Tip 1	1001 (9)	1 0011001	(19)
	2	1010 (A)	2 0101010	(2A)
NOAA-M	Tip 1	1011 (B)	1 0011011	(1B)
	2	1100 (C)	2 0101100	(2C)

*Refer to the TIP and AIP telemetry structure on pages 2020.1 through 20205. This field represents the 4-bit spacecraft ID on the downlink, and is followed by the command verification status bit which indicates command acceptance by the command decoder associated with the decoder address.

10. Response
No issues identified.

1. PAGE TITLE: Radio Frequency (RF) Telecommunications Requirements-Command Word Structure		2. REPLACES	3. PAGE NO: 2030.1
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

Command Uplink Format

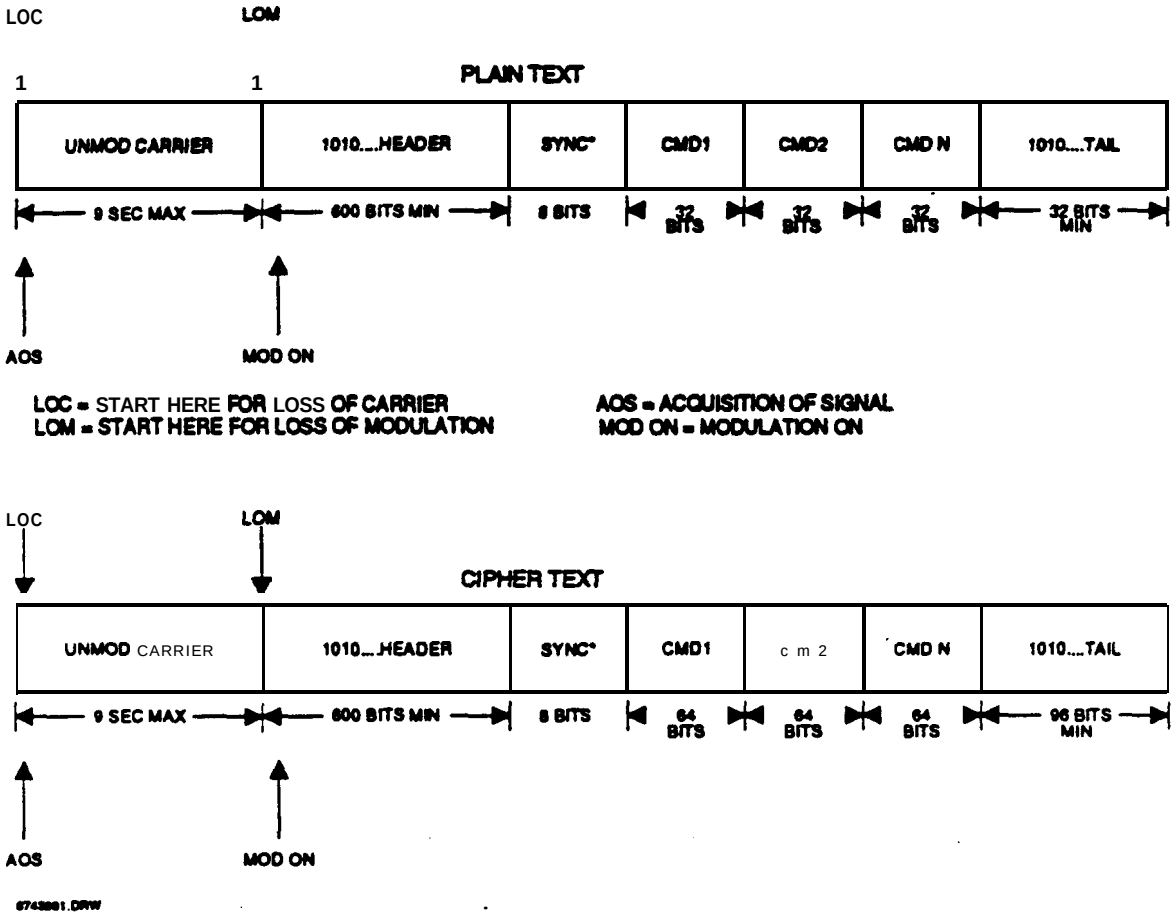


Figure 2-7. Command Uplink Format

10. Response
No issues identified.

9. Description

Command Data Structure

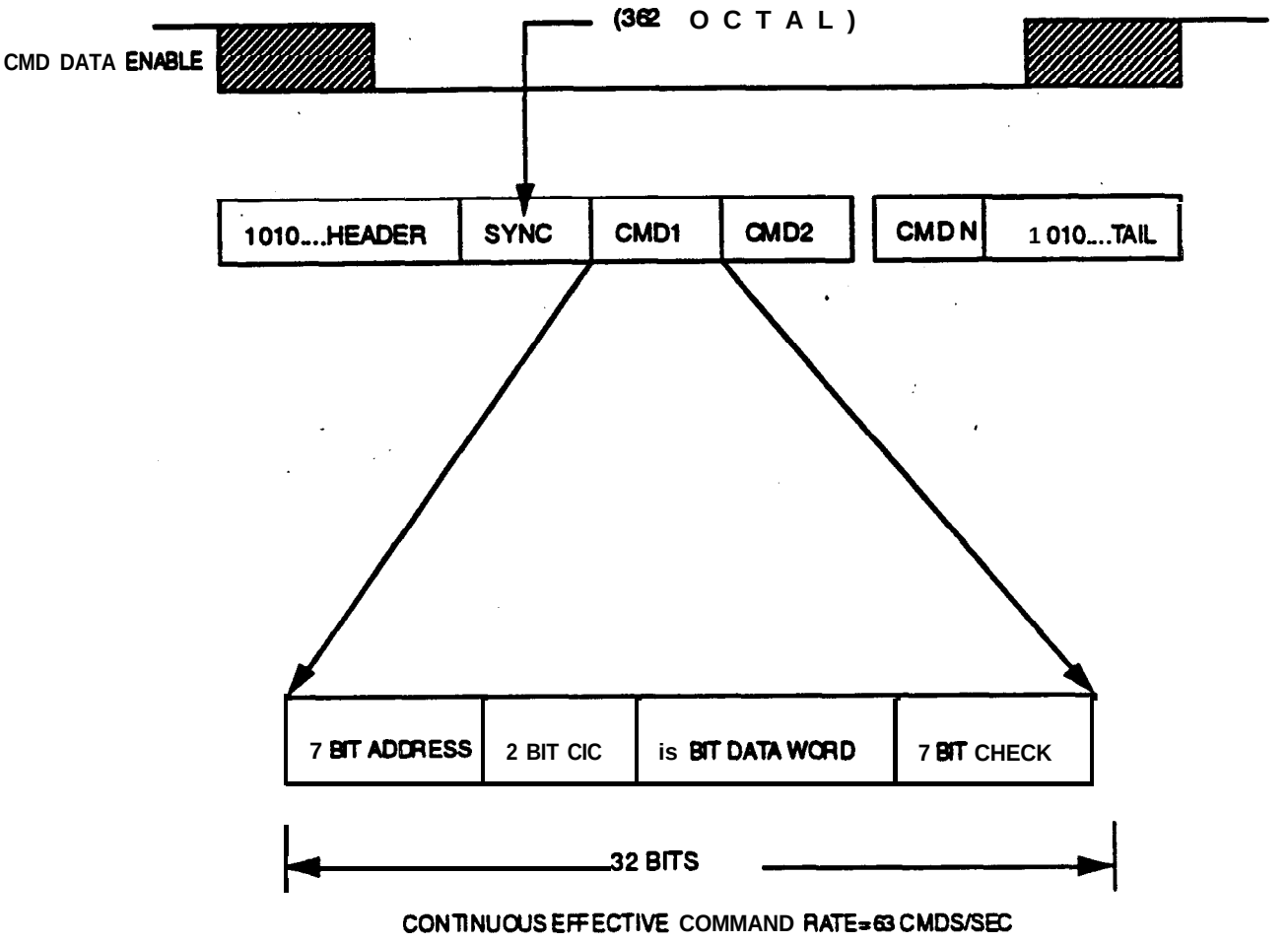


Figure 2-8. Command Data Structure

10. Response
No issues identified.

1. PAGE TITLE: Radio Frequency (RF) Telecommunications Requirements-Command Word Structure		2. REPLACES	3. PAGE NO: 2030.3
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

Uplink Command/Data Format

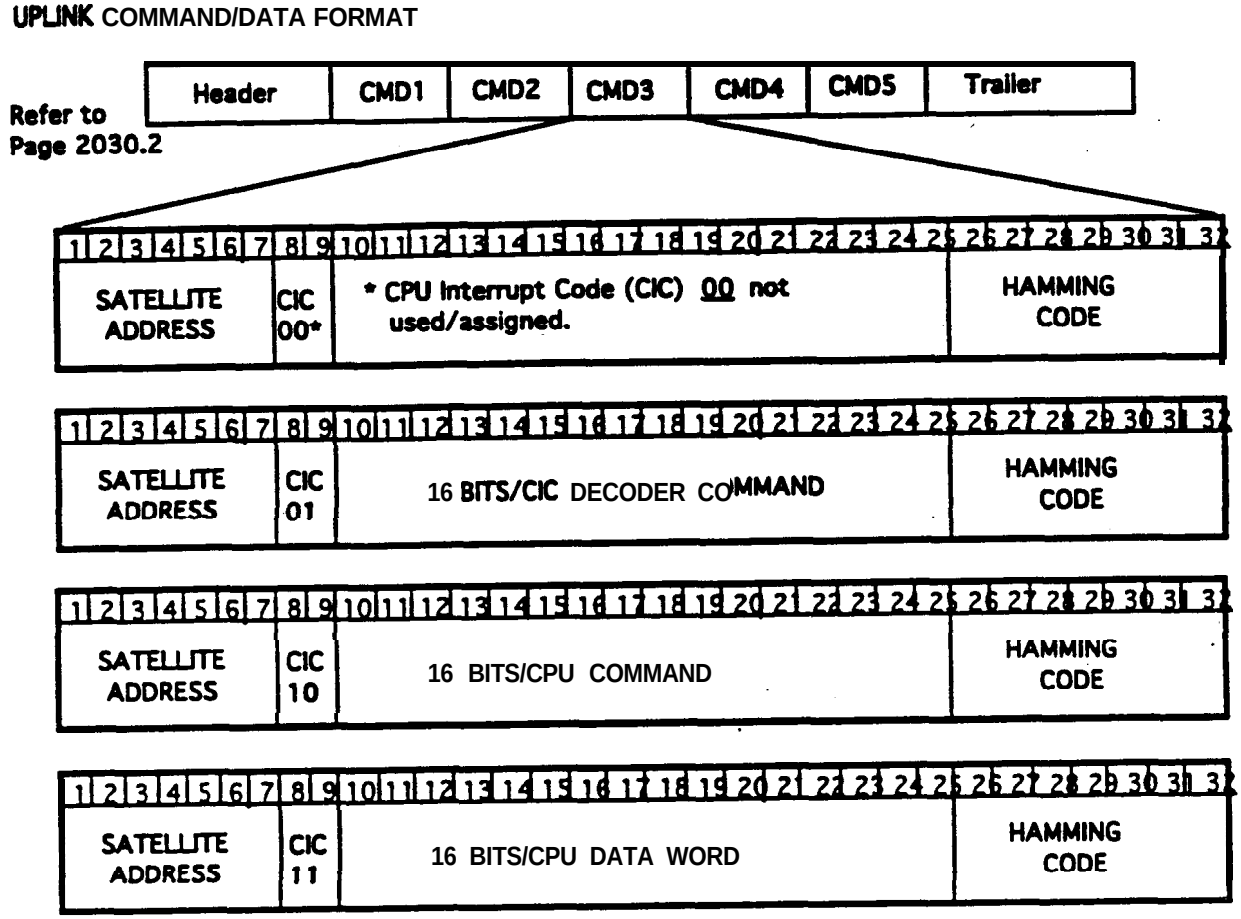


Figure 2-9. Uplink Command/Data Format

10. Response

No issues identified.

1. PAGE TITLE: DSN Requirements-Summary		2. REPLACES	3. PAGE NO: 2200
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

The NASA/DSN 26-meter subnet stations at Goldstone (DSS-16 and 9m DSS-17), Canberra (DSS-46), and Madrid (DSS-66) will be the supporting ground stations for the NOAA-K, -L, and -M missions. These stations will provide command and telemetry support until the spacecraft is turned over to NOAA for routine operational use (nominally at hunch plus 21 days). The DSN may be required for emergency support for the life of the mission. Stations will uplink the commands at 2.0-kb/sec rate, PSK modulation (NRZ-M) on the 16.0 kHz subcarrier. The downlink telemetry data consists of engineering Time Division Multiplexed (TDM) data of a 16.64 kb/sec (boost mode) or 8.32 kb/sec (orbit mode) PCM telemetry. Station processing will include PSK demodulation, bit synchronization, data recording, data blocking (Nascom 4800-bit DSN/GSFC DGIB), and data transmission via Nascom/GCF to the SOCC at Suitland, Maryland.

Summary of Support Codes

The following are the various Support Identification (SUPIDENT) and Spacecraft Identification (SCID) codes for NOAA-K, -L, and -M.

	NOAA-KLMN/SUPIDENT	WY7631	-L/Y7613	-M/Y2500
a.	Spacecraft ID	111 (octal)	120 (octal)	123 (octal)
b.	Data Stream ID (Orbit)	136 (octal)	136 (octal)	136 (octal)
c.	Data Stream ID (BOOST)	137 (octal)	137 (octal)	137 (octal)
D.	TLM Destination Code	321 (octal)	321 (octal)	321 (octal)
e.	CMD source code	321 (octal)	321 (octal)	321 (octal)
f.	DSN Source/Destination Code			
g.	(1) DSS-16: 204 (octal)			
	(2) DSS- 17: 333 (octal)			
	(3) DSS-46: 225 (octal)			
	(4) DSS-66: 366 (octal)			

Station Acquisition Data

Acquisition data will be supplied by the GSFC FDF. The FDF will coordinate and send acquisition data to the DSN stations and DSN NOCC for the LEO period. After spacecraft support transition to NOAA, the FDF will send state vectors on a routine basis to the DSN NOCC as specified in Section 7000. The state vectors are generated from USSPACECOM C-band two- or three-line elements processed by FDF.

Metric Tracking Support

There are no S-band metric trucking requirements for NOAA-K, -L, and -M.

10. Response

The DSN will provide LEO support on a scheduled basis. In addition. the DSN will provide emergency support on a one-hour call-up basis.

1. PAGE TITLE: DSN-Downlink Requirements			3. PAGE NO: 2220
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

a. Interface to a Nascom 4800-bit DGIB to receive TDM telemetry data.

b. Provide composite transfer frame data capture and frame synch lock status in near-real time.

c. Provide temporary data storage on-site for up to 7 days.

d. Provide playback of ground-recorded data to NOM SOCC on request.

e. Provide a test data generator or equivalent (test tape source) at the station for test telemetry generation during test phases of the mission.

f. Provide prepass test telemetry data flow.

g. Support downlink of orbit mode telemetry (8.32 kb/sec) on the 2247.5 MHz BPSK carrier.

h. Support, in case of contingency. the boost mode telemetry (16.64 kb/sec) on the the 2247.5 MHz BPSK carrier.

i. Provide voice link(s) to NOAA-SOCC.

j. Provide emergency support as requested during mission operations.

k. Provide 95 to 100 percent of downlink telemetry in real time to NOAA-SOCC (six contact periods/day during the LEO phase and four contacts/day during the A&E phase).

Note: The DSN shall ensure that reliability of successful error-free telemetry reception and real-time transmission to the NOAA/SOCC shall be 95 percent or greater.

10. Response

The DSN will support the downlink requirements identified. This data will be provided in the command format identified in the GSFC/DSN ICD.

1. PAGE TITLE: DSN-Uplink Requirements		2. REPLACES	3. PAGE NO: 2230
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

a. Interface to a Nascom 4800-bit DGIB interface to transmit commands on the 2025.0 MHz (25 MHz bandwidth) uplink.

b. Provide uplink modulation of NRZ-L 'one' and 'zero' idle pattern and command transmission of SOCC-generated NRZ-M command frames. (Nascom header is NRZ-L coded 4800-bit DGIB blocks.)

c. Provide prepass command test data flow.

d. Provide support for commanding at a bit rate of 2 kb/sec on a 16-kHz PSK subcarrier (square wave).

e. Provide command echo capability.

10. Response

The DSN will support the uplink requirements identified. This data will be provided in the command data format identified in the GSFC/DSN ICD.

1. PAGE TITLE: Interagency Requirements-Summary		2. REPLACES	3. PAGE NO: 2500
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REv.No.

9. Description

DOD Facilities

These requirements will be translated into the Universal Documentation System (UDS) format for transmission to DOD facilities as required by Memorandum of Agreement (MOA). The requested support will be documented in a Program Requirements Document (PRD) and is shown on page 2500.1.

NOAA Facility

Per NASA/NOAA MOA

10. Response

1. PAGE TITLE: Interagency Requirements-Summary		2. REPLA	3. PAGE NO: 2S00.1
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

Item No.	Data System and Frequency	Mission Interval (Range-Alt-Time)	Data PTS/Sec	Data Accuracy	Real-time Relay	Remarks
1.	WR C-band radar	Liftoff through LOS at WR.	-	Best obtainable	C-band radar data to GSFC	Used to derive a preliminary estimate of the orbit (from TITAN).
2.	AF ARIA, satellite telemetry data (2247.5 MHz)	A/C positioned to cover specified interval of boost phase.	-		Telemetry data via comm satellite to WR ATNAGE.	Used by ATNAGE to obtain injection vector for relay to GSFC by voice and TWX.
3.	AFSCN, satellite house-keeping data (2247.5 MHz)	Launch + 24 hours nominal	-		AFSCN Sunnyvale through GSFC to NOM SOCC.	Post-launch nominal support.

10. Response

Requirements to be levied on DOD facilities through MOA

1. PAGE TITLE: Testing and Training Requirements		2. REPLACES	3. PAGE NO: 3000.1
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REv.No.

9. Description

Forecast of Testing Schedule

There will be two categories of testing for the NOAA-K, -L, and -M series of spacecraft: (1) compatibility and (2) mission readiness testing.

Compatibii tests consist of the standard nine groups (calibrations, SK carrier, telemetry, command, security, recordings, acquisition/tracking, and special). These tests will be performed at the spacecraft manufacturers facility, using the Goddard CTV and the DSN CTT and the Suitland SOCC. These tests are performed about the time of the S/C thermal vacuum and pre-thermal vacuum testing preparation.

The network/mission readiness testing is a series of tests with support elements which are part of the launch and mission network. The network consists of the LCR at the SOCC, NOAA CDA stations, WR, DSN Operations, Nascom. FDF, NCC, and AFSCN (selected tracking stations). These tests will check out/verify voice and data circuits and operational procedures. Test activity will start around 7 weeks-prior to launch and continue until day T-l.

10. Response

The DSN will support Test and Training as requested. The DSN interface for all DSN testing is the Network Operations Project Engineer, Mr. Arthur J. Landon.

1. PAGE TITLE: Compatibility Testing		2. REPLACES	3. PAGE NO: 3100
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

General

Compatibility testing verifies that spacecraft/network telemetry, tracking and command parameters, and equipment are compatible and conform to the aerospace data systems standards and spacecraft performance specifications. Compatibility tests are designed to ensure feasibility of the intended ground station and control center operational support configuration and evaluate areas of potential support difficulty. The tests verify compatibility, identify interface limitations, and provide the network stations with advance information about the spacecraft's operational characteristics.

Compatibility Testing

Compatibility testing will consist of a series of tests involving the actual NOM spacecraft and the Goddard CTV, DSN CTT, and the SOCC facilities at Suitland. A series of standard tests (calibration, S/C carrier, telemetry, command, security, recordings. acquisition/tracking, and miscellaneous) will be performed. In addition. special tests which are unique to NOM spacecraft and/or the DSN will also be performed. Testing will occur sometime during the spacecraft integration time period.

10. Response

The DSN will support compatibility testing using the DSN CTT at a date and time to be negotiated. This testing will be in concert with the GSFC compatibility testing, if the GSFC CTV is used.

1. PAGE TITLE: Network Readiness Testing		2. REPLACES	3. PAGE NO: 3200
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

Network readiness testing will meet the spacecraft objectives by **the** network stations **and control center through a comprehensive series of tests that will progressively verify operational readiness of mission support. These test activities are required to verify operational procedures, interfaces, and suppon system hardware and software which will lead up to end-to-end simulations that demonstrate the network support p o s t u r e .**

Simulations/Test Conductor

The simulation/test conductor may be present at either **the** operation control center **responsible** for **the** supporting ground network (NCC or NOCC) **or** the users entity. The test conductor performs the following:

a Disseminates a test plan such as Briefing Messages or **printed** documents to all participating entities.

b. **Schedules requirements for all participating entities.**

c. Establishes voice and data circuits.

d, Directs all activities **throughout the duration of the simulation or data flow with all participants.**

e. Conducts a debriefing at the conclusion of the simulation or data flow.

f. Generates all necessary post-activity reports and distributes the **reports** to all participants.

10. Response

The DSN will support the Network **Readiness** Testing as requested. The DSN **interface** for **all** DSN **tests** is the Network Operations Project Engineer. Mr. Arthur J. **Landon.**

1. PAGE TITLE: Mission Readiness Testing		2. REPLACES	3. PAGE NO: 3300
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REv.No.

9. Description

A series of readiness tests will be performed about 7 weeks prior to launch up until day T-1. These series of tests will verify voice circuits, data lines, and operational pro&u&protocol. Verification will be performed through planned data flows, voice and communication script simulations, comprehensive operational simulations, dress rehearsal, and participation in prelaunch countdown activities

Participating in these tests will be the two NOM CDA stations, the GSFC NCC, the JPL NOCC and DSN stations, the AFSCN RTS's and the WR. Not all stations will be involved with each test/activity. The focal point for all activity will be the LCR located at the SOCC, Suitland, MD, GSFC/NCC and/or the NOCC at JPL. All activity will be coordinated by the METSAT Mission Operations Manager.

10. Response

The DSN will support the Mission Readiness Testing as requested. The DSN interface for all DSN tests is the Network Operations Project Engineer, Mr. Arthur J. Landon.

1. PAGE TITLE: Simulators and Test Tools		2. REPLACES	3. PAGE NO: 3400
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOM-K. -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

The TIROS Dynamic Flight Simulator (TDFS) is a simulator, which provides a dynamic hardware/ software model of the NOAA/TIROS spacecraft, will be used to simulate spacecraft operations and activities. This unit, located at the SOCC, Suitland and MMAS, will simulate flight activity from launch through the first five orbits. The TDFS is capable of verifying command procedures and schedules as generated by the SOCC. In addition, the TDFS will verify adequate operation of visual displays and print out displays in the LCR. This test will be performed by SOCC and the Wallops and Fairbanks CDA stations.

Simulated Items

For NOAA-K, -L, and -M spacecraft, an analog telemetry tape will be recorded at MM AstroSpace using a live spacecraft as a source. Tapes will be duplicated at GSFC and sent to OAFB Sunnyvale, NOAA/SOCC, and JPL. The spacecraft will also be used to conduct ETE simulations with SOCC and NASA DSN via the CTV, and the DSN CTT, while the spacecraft is at MM AstroSpace.

A source of NOAA-K, -L, and -M simulated data will be supplied by the MM Training Simulator. The simulator will be capable of fully emulating commanding, telemetry. and attitude control while the spacecraft is at WR. live data flows will be scheduled for a final checkout of the LCR/SOCC data bases.

10. Response
Requirements will be met_

1. PAGE TITLE: Training		2. REPLACES	3. PAGE NO: 3500
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

SOCC/PACS Systems Training Requirements

The SOCC and/or manufacturer of Flight Hardware and SOCC Systems (hardware and software) shall provide training periods to Flight Controllers in order to realize adequate training.

Purpose of Training

The purposes of training are:

a To familiarize SOCC and station personnel with the mission configuration and data characteristics.

b. To exercise ground and SOCC personnel in prescribed mission and contingency procedures under simulated mission conditions in the prelaunch, launch, and mission time lines.

c. To prepare and evaluate station data flows and engineering tests, that exercise station support systems before network simulations.

10. Response
Requirements will be met

1. PAGE TITLE: Mission Operations Center Requirements-Summary		2. REPLACES	3. PAGE NO: 4000
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

The existing NESDIS SOCC located at Suitland, Maryland, will be used for spacecraft operation from pre-launch activities and launch through the mission lifetime. Following completion of spacecraft evaluation and checkout, the spacecraft will be transferred over to NOM for operational use. Specifically, SOCC is responsible for the following:.

a. Controlling the NOM ground communications network.
b. Originating operating schedules.
c. Originating stored and real-time co&and schedules.
d. Maintaining onboard ephemeris.
c. Transmitting operating schedules and command programs to the CDA stations.
f. Receiving command verification from the satellite.
g. Receiving, analyzing, evaluating, trending, and disseminating all satellite housekeeping data.
h. Operating the spacecraft in support of NASA's activation and evaluation of the spacecraft bus and instruments.

10. Response
No issues identified.

1. PAGE TITLE: Mission Operations Systems Requirements		2. REPLACES	3. PAGE NO: 4100
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOM-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

General

The SOCC in Suitland, MD, will be the central point-of-control for all NOM spacecraft operations, and will interface with all supporting ground system elements. Requirements will be defined for the following categories: interfaces, real-time telemetry processing, off-line processing, commanding, d&plays, history data processing, data base management, tests and checkout, scheduling, and facilities.

A principle operating feature of the NOAA-K, -L, and-M system is the centralized remote control of the satellite through the CDA stations by the NOAA National Environmental Satellite Data and Information Service (NESDIS) SOCC. The ground system is made up of the PACS and the central processing system designated the DPSS. The SAR ground system consists of the LUT's and MCC.

CDA Stations and Ground Communications

The primary command and data acquisition stations are located at Fairbanks, AK and Wallops Island. VA. The CDA stations transmit command programs to the satellite and acquire and record meteorological and engineering data from the satellite. All data transmitted between CDA and Suitland is via commercial communications links. This ground communications link is provided by the Satellite Communications Network (SATCOM) and Nascom. Nascom provides any launch-unique communications links for satellite launch. SATCOM provides all voice and data links between the SOCC and CDA stations after launch. SATCOM is provided and operated by NESDIS.

NESDIS CEMSCS

The CEMSCS acquires data from the CDA stations via the SOCC and is responsible for data processing and the generation of meteorological products on a timely basis to meet TIROS program requirements. NOAA provides all hardware and software for the CEMSCS. NOAA will provide ephemeris data and strip out SAR data from MIRP/GAC data dumps and transmit *them to the* US and Canadian SAR MCC's.

NASA Facility Support

MO&DSD support is required through the Mission Requirements Request (MRR) per Appendix A of this DMR, with other support as described in the Memorandum of Agreement (MOA). In addition to the above. the MRR acceptance by the NASA Office of Space Communications (Code 0) will require the DSN to support the Metsat Project during the launch and early orbit phase and emergency support during the mission phase as required.

10. Response
No exceptions identified.

9. Description

United States Space Command (USSPACECOM)

USSPACECOM has prime responsibility for orbit determination, which includes establishing the initial solution and providing updated orbital parameters routinely throughout the life of the mission. USSPACECOM provides the orbital information through the NASA/GSFC communications and GSFC FDF to NOAA/SOCC. The FDF provides nominal prelaunch orbital and prediction information, special support for initial orbit estimation, and initial quality-control checks of the USSPACECOM orbital data. All ground attitude determination is to be accomplished by the NOM central data processing facility.

Mission Planning and Scheduling Requirements

The SOCC will interface with the DSN Scheduling Office to coordinate scheduling of the DSN/26-meter network. DSN interfacing will basically follow the procedures as outlined in the JPL/GSFC ICD (RD24). The SOCC will provide the DSN Scheduling Office with generic requirements for support 60 days prior to launch, and will update this schedule as needed. These requirements will provide enough information for the DSN to produce the strawman schedule. The SOCC will need tools to aid in the planning and scheduling of mission activities. These will include a means of interfacing directly to the external scheduling entities in a sufficient time frame to produce a conflict-free support schedule of external resources. The SOCC scheduling group will interface with GSFC NCC who will coordinate the scheduling support of the AFSCN/RTS stations.

10. Response

Requirements will be met

9. Description

System Test and Evaluation Requirements

Testing

Demonstration at contractor's facility of compatibility between spacecraft and ground stations (CDA stations as required) will be performed for all links. Testing will also be performed with all supporting elements which will include ETE testing and data flows from all supporting agencies.

Purpose of Simulation

Verify that *station* quipmcnt is capable of supporting the spacecraft. Familiarize station personnel with NOAA-K, -L, and -M operating procedures and command functions Ensure the adequacy of network program procedures and the readiness of all supporting elements.

Data Requirements

The launch mode emergency S-band downlink operating at 2247.5 MHz is used during satellite ascent to recover TIP boost telemetry through the AFSCN tracking sites, DSN, and the Advanced Range Instrumentation Aircraft (ARIA) for some missions. During on-orbit operation, orbit -mode TIP will be available on this link to provide early-orbit and emergency support through the ground tracking network operated by the AFSCN in Sunnyvale, CA, and the NOCC at JPL in Pasadena, CA. Commanding will be via the SOCC/PACS on the 2025.0 MHz S-band uplink carrier.' Refer to Sections 2000 and 2500 for the support respectively provided by the DSN and AFSCN.

10. Response
No exceptions identified.

1. PAGE TITLE: Ground Communications and Data Transport Requirements-Summary		2. REPLACES	3. PAGE NO: SOW
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K-L AND-M	7. PROGRAM NO.	8. REV. NO.

9. Description

GSFC/Nascom coordination and participation is required in the set up and use of the voice and data circuits (as shown on page 5100) which arc used during prelaunch simulations and postlaunch 'satellite checkout Item 4 consists of four voice circuits (refer to page 5100): (1) Mission Conference, (2) Mission Operations, (3) Countdown Net between WR through GSFC/MMA to SOCC, and (4) NASA Project Management Net between WR and GSFUMMA

Data circuits 5 and 6 (refer to page 5100) require short-term call-up and use 56 kb/sec lines for launch support. Data format will be message-switched 4800-bit DGIB blocks.

The operational phase of the NOAA-K, -L, and -M mission is the responsibility of NOAA. The only NASA requirement is to provide backup command emergency support and telemetry support from the DSN 26-meter subnet stations.

Emergency backup telemetry support will be provided by the AFSCN/RTS stations by request of NOAA via the GSFC NCC.

10. Response

Requirements will be met

1. PAGE TITLE: Ground Communications and Data Transport Requirements-Summary		2. REPLACES	3. PAGE No: 5000.1
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

Type of Service	Location of Operating Terminals	Bandwidth	Channels	Data Rates	Purpose
CDA circuits will be supplied by NOM					
Data circuits. Nascom (Message-switched 4800-bit blocked).	1. Spacecraft contractor facility, Hightstown, New Jersey to GSFC (full duplex)	56 kb/sec line		TLM: 832 kb/sec TLM: 16.64 kb/sec CMD: 2.0 kb/sec	Transmit real-time command and telemetry to/from SGCC via GSFC for evaluation.
	2. WR to GSFC	56-kb/sec line		832 kblsec 16.64 kb/sec	
	3. GSFC to NOAA/SOCC(full duplex, 2 circuits) Shared with GOES program.	56 kb/sec line		TLM: 832 kb/sec TLM: 16.64 kb/sec CMD: 2.0 kb/sec	Transmit real-time command and telemetry to/from SGCC via GSFC for evaluation. Drive displays and determine orbit.
	4. AFSCN, Sunnyvale. CA	9.6-kb/sec line		832 kblsec	Transmit real-time telemetry and data tapes to SGCC vi8 GSFC for evaluation.
	5. DSN. Pasadena, CA	56-kb/sec line (full-duplex)		TLM: 832 kb/sec TLM: 16.64 kblsec CMD: 2.0 kblsec	Transmit real-time command and telemetry to the SOCC via GSFC for evaluation.
Voice Circuits *NOAA **Nascom	GSFC-NOAA/SOCC GSFC-Spacecraft contractor facility (MM/ASD) Hightstown. WR, AFSCN and DSN	0.3 to 3 kHz 0.3 to 3 kHz			Operational coor. Operational coot. during pre- and postlaunch activities (apprx. 30 days)

Note-NOAA will provide voice and data circuits between the two CDA stations (Wallops and Fairbanks) and SOCC.

** Called up for launch supportconnects SCAMA and NOM switchboards.
* Hotlines to NOAA switchboard (provided by NOAA).

10. Response
Requirements will be met

1. PAGE TITLE: Ground-to-ground Data Transport Requirements

3. PAGE NO: 5100

4. DATE November 1993

5. PROJECT TITLE: METSAT

6. MISSION(S) NOAA-K -L AND -M

7. PROGRAM NO.

DATED:

8. REV. NO.

9. Description

A0266

Table 5-1. Data Transport

ITEM NO.	Terminals (Comm. Paths Required Between) A	B	TYPE OF COMMUNICATION REQUIRED	CAPABILITY 1W OR 2W	DATA: DATA SOURCE	DATA: SOURCE DATA RATE	DATA: DELIVERY TIME	DATA: REFERENCED PAGE	SERVICE DATE(S) AND DURATION	REQ CLASS
1	AFSCN	NOAA/ SOCC	Voice	2W	NA	NA	RT	5000	L-2 months to L+1 week	I
2	AFSCN	NOAA/ SOCC	Telemetry Data	2w	SIC	8.32 kbps	RT		L-2 months to L+1 week	I
3	WR	NOAA/ SOCC	Telemetry Data	2w	SIC	6.32 kbps	RT	5000	L-1 month to L+1 day	I
4	WR	NOAA/ SOCC	Voice	2W	NA	NA	RT	5000	L-1 month to L+1 day	I
5	WR	NOAA/ SOCC	Boost Telemetry	2w	SIC	16.64 kbps	RT		L-1 month to L+1 day	I
6	DSN	NOAA/ SOCC	Telemetry Data (Boost or orbit)	1W	SIC	16.64 kbps 1.32 kbps	RT		L-6 months to L+21 days	I
7	NOAA/ SOCC	DSN	Command	1W	NOAA/ SOCC	2kbps	RT		L-6 months to L+21 days	I
8	DSN	GSFC/FDF	Tracking/State Vectors	1W	SIC				L-1 month to L+1 week	I
9	MM/ASD	NOAA/ SOCC	Telemetry Data	2W	SIC	8.32 kbps 16.64 kb/sec			L-6 months to L-1 month	I
10	DSN	NOAA/ SOCC	Telemetry Data	1W	SIC	8.32 kbps	RT		S/C Lifetime	I
11	DSN	NOAA/ SOCC	Command	2w	NOAA/ SOCC	2 kbps	RT		S/C Lifetime	I
12	DSN	NOAA/ SOCC	Voice	2W	NA	NA	RT		S/C Lifetime	I

Note: Items 10, 11, and 12 pertain to emergency support call-up.
Item 6, boost (16.64 kb/sec) telemetry only in case of contingency.

A0266

Table 7-1. Trajectory and Attitude Requirements

1. PAGE TITLE: Trajectory and Attitude Support Requirements

2. REPLACES

3. PAGE NO: 7000

4. DATE: November 1993

5. PROJECT TITLE: METSAT

6. MISSION(S): NOAA-K, -L, AND -M

7. PROGRAM NO.

DATED:

8. REV. NO.

9. Description

ITEM NO.	REQUIRED CLASS	DATA TYPE	MISSION PHASE	OUTPUT INTERVAL	ACCURACY	DELIVERY SCHEDULE	PURPOSE
1	NA	C-band position and velocity data	Liftoff thru TITAN burnout		Best Obtainable	Station Capability	Compute preliminary orbit
2	NA	S/C ascent telemetry data	Liftoff to end of ARIA coverage		Best Obtainable	Aircraft Capability	Obtain parameters from S/C onbaord computer
3	NA	Air Force spacetrack radar tracking data and state vector, TITAN II and WR-ATNAGE orbit-al parameters	Early orbit operation		Best Obtainable	Station Capability	GSFC responsible for data handling, data distribution, and determining if immediate update of prelaunch nominal acquisition and planning aid data is necessary
4	NA	Air Force spacetrack radar tracking data-state vector	Activation and Evaluation (A&E) phase (L+21 days)		Multi-line elements	Station Capability	For GSFC and NOAA orbit propagation and related computations GSFC to supply scheduling aids weekly to NOAA an AFSCN
5	NA	Air Force spacetrack radar tracking state vector	S/C normal operations (there will be two S/C operational at a time)		Three-line elements	Daily	For NOAA orbit propagation and related computations

10. Response
Requirements will be met.

1. PAGE TITLE: Trajectory and Attitude Support Requirements		2. REPLACES	3. PAGE NO: 7000.1
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO.	8. REV. NO.

9. Description

USSPACECOM has **prime** responsibility for trajectory support for **the** NOAA-K, **-L,** and -M missions by supplying the appropriate two- or three-line elements from C-band skin trackers to the GSFC FDF. The FDF in turn will provide acquisition data for the supporting networks and NOAA.

Acquisition Data

The FDF generates and transmits **nominal acquisition data in the form of INP/IIRV's to supporting stations by** F-30 days. During the period from liftoff through liftoff plus 24 hours, acquisition data is generated using orbital **information.** provided by the **Metsat Project. FDF also receives and verifies a theoretical** trajectory from the WR computers before the **first** simulation. FDF will provide scheduling aids at **F-** 10 days to the project

Launch Phase

There **are** no real-time acquisition data requirements for the **launch** vehicle or spacecraft Stations **will** use **nominals** supplied by FDF at F-30 days and updated by F-l day if **required.**

10. Response

FDF generates **and** transmits NOAA spacecraft acquisition data to **NOAA/CDA, NASA/DSN, and AFSCN/RTS** stations **based** on two-line elements received from USSPACECOM at **Launch** plus 3 hours.

1. PAGE TITLE: APPENDIX A-MRR		2. REPLACES	3. PAGE NO: A-I
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, and -M	7. PROGRAM NO.	8. REV. NO.

REQUEST FOR OFFICE OF SPACE COMMUNICATIONS SERVICES
(NASA NMI8430.1C Mission Requirements Request, MRR)

Approved Form OMB No.
MRR Submission Date:
Change No.
OSC Use.

NOTE: *Please read and detach instructions before completing this request.*

TO: National Aeronautics and Space Administration
Office of Space Communications
Code O
Washington, D.C. 20546

FROM: Requesting Office/Agency Name and Address:
Metsat Project/NASA, GSFC
Principal Contact/ Name, Phone, Position/Title
David Coolidge, 286-8331, Systems Mgr

I. MISSION INTRODUCTION

1. Mission Title: Advanced Television Infrared Observation Satellite (Tiros) NOAA K,L,M,N

2. Mission Objectives (1100):
To procure, develop, test, and launch four spacecraft.
To meet NOM's critical requirement for continuous and dependable operation of the polar orbiting satellite element of it8 satellite system.

3. Category/Sponsor (1000):
☐ NASA ☒ Non-NASA Government ☐ NASA Cooperative ☐ Foreign Commercial
☐ DoD ☐ Foreign Government ☐ U.S. Commercial ☐ Other
If Other, Describe:

4. Launch Area Information (1700):
☐ Space Shuttle LV ☒ Expendable LV ☐ Aircraft ☐ Other
Specify: Vehicle Titan II Upper Stage Thiokol TE-M-364-15
Launch/Operations Site: Western Test Range, Vandenberg AFB
Trajectory Regime Description: Direct ascent
Launch Date(s): 2/95, 7/96, 2/97, 2/99

5. Orbit/Path Data (1700):
☐ Aeroflight ☐ Suborbital ☒ Low-Earth Orbit ☐ High-Earth Orbit ☐ Deep Space ☐ Othe
Specify Orbital Parameters as Applicable:
Apogee 833 km AM 870 km PM Perigee 833 km AM 870 km PM Inclination 98.7° AM, 98.86° PM
Other Trajectory Information (See DSN): Not applicable
If Other, Please Describe:

6. Key Mission Events and Dates (1100):
Mission Duration (mo/yr); Prime: 2 years Extended: 3 years

7. Other Information:
Approved Mission Start Oac/D 6/86 Phase Start Date: 6/88
Present Phase of Development (pre A, A, B, C, D,): D
Requirements Maturity Assessment: ☒ > 80% ☐ > 50% ☐ < 50%
Funding Approval Status: Approved
Spacecraft Autonomy/Self-protection Potential: Encrypted Command Link. Autonomous Computer Control system

8. Points of Contact (1000):
Mission Lead Center: Goddard Space Flight Center
Project Manager: Charles E. Thienel Phone: (301) 286-6869

II. OSC SERVICES REQUEST

A. GENERAL FACILITIES SUPPORT

. OSC Data Acquisition Services Anticipated, by Mission Phase/Type (1100):

OSC Data Acquisition Networks	Aero	Suborb	Launch/Inject	Orbital	Cruise	Encount.
WFF						
DFC						
SN						
DSN				X		
GN						
RTS			X	X		
ETR/WTR			X	X		
Additional:			ARIA(2)			

Specify NOAA CDA Stations (Wallops and Fairbanks) provide command and telemetry support. Prime for all phases on orbit.

. Mission Operations Concept Related to OSC Services (1100):

Mission Control Center Location NOAA Satellite Operations Control Center, Suitland, MD

Remote Science (PI) Centers NOAA provided

Data Archives NOAA provided

OSC Facility Interface GSFC/NASCOM

. OSC Data Transport Facility Services (2700):

Brief Data Transport Network Description Real time telemetry and command, NASCOM 4800 bit blocks

Terminal Locations WTR, GE/Astro, AFSCN, GSFC, DSN, NOAA/SOCC, WLPS, FBK

Nascom Requirements: ☒ VOICE ☒ DATA ☒ TTY ☒ VIDEO ☐ PSCN Highest Data Rate: 16 64 KBPS

. OSC POCC Facility Services (3000):

OSC-Provided POCC YES ☐ ☒ NO (IF NO, SKIP TO #5) Location

Command Management Services ☐ Mission Planning Services ☐

Spacecraft Autonomy Design:

Average Command Activity by Mission Phase Hours per Week Minutes per Pass

. OSC Flight Dynamics Facility Services (2100):

FDF ☒ NAV ☐ Other No. of S/C Vehicles All missions

Attitude Determination ☐ Orbit Determination ☒ Maneuver Planning ☐ End of Life Analysis ☐

Special/Non-Standard Services: NORAD provided orbital elements.

. OSC Data Processing Facility Services (400(: Not applicable

Telemetry Data Rate No. of Channels

Data Input Data Delivery Process Level

Radio Metrics Accuracies Types

No. of Channels Data Input

Data Delivery Process Level

Command Data Rate RT/Store-Forward

Data Input Data Delivery Process Level

Location

7. Other Non-Data Acquisition Network OSC Services:

Network-Spacecraft Compatibility Testing Required (1600) ☐ L-24 Months ☒ L-12 Months ☐ L-6 Months ☐ L-3 Months

Interfacility Tests and Simulations (3000): ☐ L-24 Months ☐ L-12 Months ☒ L-6 Months ☒ L-3 Mo

NCC/MMA

II. OSC SERVICES REQUEST (Cont'd)

B. DEEP SPACE NETWORK

(Fill Out I, Mission Introduction, and IIA, General Facilities Support, as Applicable)

1. Telecommunications and Radio Metric Link Characteristics (1400):

Uplink Frequency (s) 2025 MHz Bandwidth 280 KHz

Downlink Frequency (s) 2247.5 MHz Bandwidth 0.94 MHz

Number of R. F. Links 2 (1 uplink and 1 downlink)

Spacecraft Xmit Power, Watts, EIRP, per Link +24 dBm/RCP

Spacecraft Receiver G/T per Link

Spacecraft Required Receive Power, dBm -118 dBm (min) - 30 dBm (max)/RCP

Radar EIRP and G/T Performance Not applicable

OSC Insitu Telecomm Relay Required Real time

- Link Analysis attached (if available) (MTI)

2. Data Types Required:

2200 Telemetry Links	Data Rate Range	Format CCSDS	Format Other	Real Time	Recorded	% Data Return	Duration/ Period
S-Band	8.31/16.64 KBPS		X	X		100	15 Min.

2300 Command Links	Data Rates	Format CCSDS	Format Other	Real Time	Store Forward	Duration/ Period
S-Band	2 KBPS		X	i	X	15.

2100 Radio Metrics	Nav. or Science	Accuracy	1, 2, 3-Way Mode	System Stability	Duration/ Period
Range	Not applicable				
Range Rate					
Angle/VLBI					
Other					

Radio Science Data Handling Requirements

3. Coverage Requested (1100): Launch and contingency call-up support

Phase (Define phase and period):	LEO/4 days		Contingency/21 days		Emergency/TBD			
Passes/Month	8/day		8/day		8/day			
Pass Length (hour)	.15 min.	-	15 min					
Antenna Expected (9, 11, 26, 34, 70M)	26	---	26		- UP - - - - - -			
Max Angle Rate (Near Earth)	3°/sec		3°/sec				3°/sec	

LEO-Launch and Early Orbit

4. Deep Space/Lunar Trajectory Data for Pointing Information (1700): Not applicable

Geocentric Range, or Max Comm Range

Declination/Right Ascension vs Time (Submit table)

Applicable State Vector

MISSION REQUIREMENTS REQUEST

NOAA-K,L,M,N ATTACHMENT

Telecommunications and Radio Metric Link Characteristics

LINK	FREQUENCY	DATA RATE	MODULATION	SUB-CARRIER	MOD INDEX
Command	2025 MHz	2 kbps	BPSK(NRZ-M)/PM	16 kHz	1.0 radian
Telemetry	2247.5 MHz	8.3/16.6 kbps	PCM/BPSK/PM	None	± 67° deg peak

M.C.
7/9/93

ROUTE SHEET

CODE	BLDG. / ROOM	NAME	PURPOSE*	INITIALS	DATE	REMARKS
501		Mr. McKenzie	5.	11/17/93		Hand-Carry Codes 480-500
501		Mr. Harris	2.		11/17/93	
480		Mr. Draper	6.		11/19	Signature Requested
480		Mr. Thienel	6.		11/23	Signature Requested
501		Mr. McKenzie	6.			Signature Requested
500		Mr. Fahnestock	2.,6.			Signature Requested
501		Mr. McKenzie	5.			2-Day Mail to JPL
JPL		Mr. Luers	5.			
JPL		Mr. Haynes	6.			Signature Requested
JPL		Mr. Luers	5.			2-Day Mail to GSFC
501		Mr. McKenzie	5.			Publish & Distribute

* PURPOSES

1. FOR INFORMATION
2. FOR APPROVAL
3. PREPARE REPLY
4. PREPARE ENDORSEMENT
5. FOR NECESSARY ACTION
6. FOR SIGNATURE
7. RETAIN ENCLOSURES
8. RETAIN COPY

MAILROOM USE ONLY

SOURCE/SENDER	IDENT. SYMBOL & DATE
J. S. McKenzie	Code 501

SUBJECT:
Approval of Detailed Mission *Requirements* (DMR) Document for National Oceanic and Atmospheric Administration (NOAA) -K, -L, and -M; DMR Issue 1 , November 1993

FORWARDED BY	DATE FORWARDED
Flight Mission Support Office	11/17/93

EXT.	CODE	BLDG.
6-8447	501	12/E225

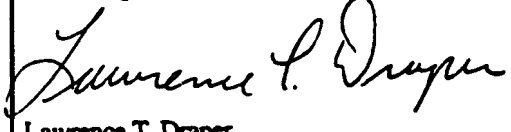
GSFC 11-20 (10/64)

1. PAGE TITLE: APPROVAL AUTHORITY		2. REPLACES	3. PAGE NO: 1010
		DATED:	4. DATE November 1993
5. PROJECT TITLE: METSAT	6. MISSION(S) NOAA-K, -L, AND -M	7. PROGRAM NO. UPN 615-3	8. REV. NO.

9. **AUTHORITY (REFERENCES)**

a NASA **Management Instruction (NMI) 8430.1C**
b. Execution Phase Project Plan for NOM-K, **-L, -M**
c. Mission Requirements Request (MRR) (refer to attachment A)

10. REMARKS
This DMR applies to the NASA Office of Space Communications (OSC) managed resources in support of the NOAA-K, -L, and -M missions. Any other reference is supplied only for completeness of the document

PROJECT CENTER(S)		SUPPORT CENTERS	
11. **REQUIREMENTS PREPARED BY:**  **Lawrence T. Draper** **Deputy Project Manager** **Code 480** **Goddard Space Flight Center**	**DATE** 11/19/93	12. RESPONSES PREPARED BY: **Jeffrey S. McKenzie** **Mission Support Manager** **Code 501** **Goddard Space Flight Center**	**DATE**
13. REVIEWED BY:  **Charles E. Thienel** **Project Manager** **Code 480** **Goddard space Flight center**	DATE 11/25/93	14. APPROVED BY: **Dale L. Fahnestock, Director of Mission Operations and Data Systems** **Code 500** **Goddard Space Flight Center**	DATE
		15. REVIEWEDBY: **N. R. Haynes, Assistant Laboratory Director Telecommunications and Data Acquisition** **Jet Propulsion Laboratory**	DATE

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SOURCE/SENDER: J. S. McKenzie

IDENT. SYMBOL & DATE: Code 501

SUBJECT: Approval of Detailed Mission Requirements (DMR) Document for National Oceanic and Atmospheric Administration (NOAA) -K, -L, and -M; DMR Issue 1 , November 1993

FORWARDED BY: Flight Mission Support Office

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EXT.: 6-8447

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BLDG.: 12/E225

GSFC 11-20 (10/64)

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